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MANUAL OF HYGIENE.

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MANUAL OF HYGIENE

BY

I. WHITE WALLIS.

MEMBER OF THE SANITARY INSTITUTE.

Hygiene is the Art of preserving health . . . it aims at rendering growth more perfect, decay less rapid, life more vigorous, death more remote.—*Parkes' Practical Hygiene.*

LONDON:
KEGAN PAUL, TRENCH, TRÜBNER & CO., LTD.

1894.

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TO

SIR DOUGLAS GALTON, K.C.B., D.C.L., LL.D., F.R.S.,

WHOSE INFLUENCE AND COMPREHENSIVE INTEREST

IN THE DIFFUSION OF SANITARY KNOWLEDGE

HAVE TENDED TO MATERIALLY PROMOTE

THE INCREASE OF

HEALTH AND HAPPINESS.

PREFACE.

HYGIENE has now become such a recognised subject of study, that a large number of books has been published, mostly intended for use in special cases—such as for the preparation for Medical and other Examinations, for Householders, and even for the guidance of School Managers. In England, however, no effort appears to have been made to arrange the subject and its relation to the other sciences, in a manner suitable for the study and education of children before leaving school—the time most important, perhaps, for securing the general information of the people in the subject of Hygiene, and its bearing upon Health and Happiness.

This Science is largely taught in the Normal Schools in Belgium and other parts of the Continent, and the present work was suggested in reading the admirable little book :—Manual d'Hygiène Privée, by Doctor E. Schrevens, Professor of Hygiene at the State Normal School at Tournai, who has courteously authorised the use of any part of his book. The Manual has been carefully compared with the best authorities to bring it up to date, and to make it suitable for the use of the elder classes of the English Schools.

I. White Wallis.

May, 1894.

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MANUAL OF HYGIENE.

INTRODUCTION.

AIM AND IMPORTANCE OF HYGIENE.

"HYGIENE is the art of preserving health . . . It aims at rendering growth more perfect, decay less rapid, life more vigorous, death more remote." It will be seen from this concise definition by Dr. Parkes that Hygiene deals with all things that affect the health of the community. It goes beyond the science of curative medicine in that it deals with all causes that tend to produce sickness and disease, and it is therefore frequently termed the Science of Preventive Medicine. But further than this, it aims not only at preventing disease but at surrounding the individual with those conditions which tend to promote health, long life and happiness.

Hygiene is therefore a subject of the utmost importance to everyone from a moral, social, and even monetary point of view; a healthy body conduces to a healthy mind, and a healthy people are generally a wealthy people. In fact, the force and vigour of a nation depends on the laws of Hygiene being thoroughly understood and conscientiously observed by every individual.

If Hygiene is not yet appreciated as it should be, it is because its importance is still too much ignored, and because the rôle which it plays in the life of individuals, of families, and of nations, is not generally understood.

To none can the study of Hygiene be of greater importance than to the young who are just forming the ideas and the habits which are to guide them in after-life; more especially at a time when they are best able to study the logical reasons for these ideas and habits in connection with the forces of nature by which they are surrounded, and in conformity with which they have to live.

I.—HEAT.

HEAT AS A PHYSICAL CONDITION.

Before we can study the action of external heat upon the living organism, we must understand the conditions of the organism itself; must see how its temperature is regulated and in what way it is connected with external heat. We shall therefore divide this subject into two parts: Animal heat, or the heat produced within the human organism; Cosmic heat, or the heat derived from the sun.

ANIMAL HEAT.

Animals are distinguished from inorganic substances by their power of producing heat. Minerals are cold or hot according as the influences to which they are subjected from outside are heating or chilling.

Cold-blooded animals are almost entirely dependent on the sun, for the heat which is the source of their vital force; and their temperature rises or falls with the temperature of the medium with which they are surrounded. Man and all warm-blooded animals, by means of combustive processes which take place within them, generate heat and are therefore able to maintain the temperature of their bodies at an almost constant standard, in spite of the varying atmospheric influences to which they are exposed.

Those parts of the body which come into contact with the atmosphere, such as the skin and mouth, naturally vary more in temperature than the deep-seated internal organs. The axiliary temperature, which is the temperature under the arm-pits, gives the average for the human body; this varies from 96° to 98°.

Sources of Animal Heat.

Various influences modify the heat of the body, but before considering these we must understand how animal heat is produced.

Heat is produced in the body by the process of combustion which takes place within it. By respiration, oxygen from the external air is received into the lungs and passing into the blood combines with the carbon contained in the body to produce carbonic acid gas. This process is one of slow combustion and by it heat is evolved. The amount of heat liberated has been observed to bear a close relation to the amount of oxygen consumed and of carbonic acid given off. In cold-blooded animals respiration is feeble whereas in the warm-blooded animals the quantity of oxygen consumed is very large. The carbonic acid and water formed by combustion within the body are exhaled by respiration.

Oxygen acts likewise upon certain components of the food which has been eaten, and by this means also produces combustion and consequently heat. Every change in fact in the organic components of the body in which the elements enter into new combinations with oxygen is a source of heat.

Respiration, the oxidation of food, and organic combustion are therefore the sources of animal heat.

The constancy of the temperature maintained by the body shows that it possesses within itself a regulating power. When exposed to cooling influences from without, the process of combustion takes place with greater activity, so as to enable the body to resist these influences, while when the surrounding air is warm, less heat is generated as less is required.

Causes which increase the production of Heat.

External temperature.—External temperature influences in some degree the heat of the body. If we are exposed to external cold for some length of time, the temperature of the body will fall or if to external heat the temperature will be somewhat raised. The variation however will be only slight; for as has been already observed the body regulates to a great extent its own temperature. In cold climates the air being denser exerts more pressure on the blood-vessels of the lungs, and thus more oxygen is absorbed and the heat of the body maintained.

Alimentation.—We have already said that heat is produced by the union of oxygen with some of the components of food. It is a common experience that during cold weather, the desire for food is greater than in warm weather, and, if supplied with suitable nourishment, man can sustain extreme cold without any considerable lowering of his temperature. Of the foods we eat, fats and oils (hydro-carbons) generate more heat than the saccharine and albuminoid substances. It is a notable fact that in cold climates fatty and oleaginous foods are naturally preferred.

Organic function.—The excessive exercise of any part of the body muscles nerves glands etc., causes a rise in the temperature of the whole body.

During fever an excessive production of heat takes place, but in the case of local inflammation and sores a local rise of temperature is often occasioned which may not be enough to produce fever or increase the general temperature of the whole body.

Causes which decrease Animal Heat.

The principal causes which decrease animal heat are Radiation, Conductibility of the surrounding media, and Evaporation of moisture from the surface of the skin and from the lungs.

The loss occasioned by radiation.—The loss of heat occasioned by radiation depends on the temperature of the surrounding atmosphere. If this is colder than that of the body a certain amount of heat will pass from the body into it but if about the same temperature the loss by radiation will be very small.

The conductibility of surrounding media.—Clothes are worn about the body to retain the animal heat and prevent its loss by radiation. Some materials however are good conductors of heat and if worn next the skin will allow the heat of the body to pass through them. These, as will be explained later on, should be avoided as articles of clothing. Wool and silk are bad conductors and therefore good as articles of clothing. Fur is also good in cases of extreme cold.

Evaporation of moisture from the surface of the Skin and from the Lungs occasions the principal loss of heat sustained by the bodily economy. We find that expired air is much warmer than inspired air. Our bodies therefore part with a considerable amount of heat with the air we breathe out.

The skin is covered with innumerable pores from which a fluid called sweat is exuded. This fluid passes off from the skin in the form of vapour. In the evaporation of the perspiration the skin parts with its heat and the temperature of the body is lowered.

In hot climates the skin is very active, the production of sweat is increased, great evaporation takes place, with the result that the blood is cooled and the temperature maintained at its normal standard. The skin and lungs are the great regulators of the heat of the body.

The body is cooled much more rapidly when the air is in motion as fresh and cool currents of air not saturated with humidity are constantly brought into contact with it. This is the reason why we are so much more sensible of cold on a windy day than on a still one.

Cosmic Heat.

Cosmic heat is derived from two sources, from the earth and from the sun. Animal heat as we have already said is evenly maintained, but cosmic heat as it affects ourselves is subject to considerable variation.

Terrestrial Heat.—The central heat of the earth has little influence on its surface and scarcely affects its normal temperature.

Solar Heat.—The heat experienced on the earth is almost entirely derived from the sun. Solar heat is therefore the chief factor in the formation of climate, which is further determined by the position of different regions on the surface of the earth and by the prevailing physical conditions of these regions. The three principal conditions influencing the healthiness or unhealthiness of a climate are: Temperature, Humidity, and the Purity of the air. The study of these is therefore of special importance to the student of Hygiene.

The Temperature of Climates.

The principal causes influencing the various temperatures of climates are four: Latitude, Altitude, Exposure of Soil and Direction of Prevailing winds, and the Neighbourhood of Water.

Latitude.—The sun is directly overhead in the tropics, its rays fall perpendicularly and with great strength on the earth and the temperature is very high. As we pass from the tropics to the Poles, the sun's rays fall more obliquely; they consequently possess less power and the temperature becomes gradually lower. The ratio of decrease varies, but for every two degrees distance from the equator there is a loss of about two degrees Fahr.

Altitude.—Temperature decreases in proportion to altitude. The rate of decrease is about one degree Fahr. to every 250 ft. ascent above the sea level, so that in the ascent of high mountains an elevation of 500 ft. is equal to a difference in latitude of about two degrees from the equator.

Exposure of soil and direction of Winds.—The temperature of a tract of country will greatly depend on its physical formation, whether it consists of plains or is protected by mountains and forests. An arid soil will be much hotter than one covered with vegetation. The direction of the prevailing winds also powerfully affects climate.

Neighbourhood of Water.—Water heats more slowly than land, but also parts with its heat much more slowly. It thus acts as a store-house for the heat it has absorbed during the summer, and parting with it gradually serves to equalise the temperature between the summer and winter months. Places by the seashore possess on this account a much more equable climate than those far inland, and the difference between the seasons is much less marked. The sea also modifies, to a certain extent, the character of the winds which blow over it; cold winds become more genial, owing to their contact with the warmer surface of the water, and hot dry winds less parching and enervating, owing to the moisture with which they have become charged in passing over the sea.

Humidity of Climate.

The warmer the air (see Chap. XI.) the more vapour of water it can contain. When the air is moist, little evaporation can take place from the skin and limbs, and consequently the blood is not cooled. Hot moist air is therefore much more trying and feels hotter than dry air at the same temperature.

Purity of the Atmosphere.

We shall not consider here the variations of the constituents of the atmosphere (this is discussed in Ch. XI.), but only its purity relative to the emanations arising from the earth, water and from human beings. To these emanations and to the influence of temperature and humidity must be attributed the prevalence in certain countries of endemic maladies, such as the plague, cholera and yellow fever. These maladies sometimes assume an epidemic character and spread from their original centre over vast portions of the earth.

In the tropical regions where perpetual summer reigns and where the difference between the seasons is at most from 9° to 12° Fahr., the great heat induces considerable emanations from the soil and vegetation, and the region becomes the birth-place of many fevers and other maladies.

The purity of the atmosphere as regards emanations from the earth seems to be in direct accord with latitude. As we advance towards the poles, the malarias disappear. The human miasmatas however take place of the natural miasmatas, and in the more temperate regions, we find the contagious diseases, eruptive fevers, typhus etc. The various conditions affecting the purity of the atmosphere will be dealt with more fully in a subsequent chapter (Chap. XI.)

PHYSIOLOGICAL AND PATHOLOGICAL FUNCTION.

Division of Climates.

From a hygienic point of view climates may be divided into three great classes :

1. The hot climate from the equator to 30° of latitude.
2. The temperate climate from 30° to 60°.
3. The cold climate from 60° to the poles.

To understand the influence of cosmic heat on the human body we must now study it under the conditions in which it acts in a manifest and lasting manner. As in the various climates of the earth.

Hot Climates.

Change in the Organism.—The human organism undergoes certain modifications when exposed to continual heat. It may be laid down as a broad principle that the body must produce as little heat as possible in surroundings where it loses little, and all the changes which the body undergoes tend to this object in a hot climate.

Although the intestinal and gastric juices which aid digestion are diminished less saliva is produced and thirst ensues, yet on the other hand the skin becomes much more active and there is a superabundance of perspiration. And while the urinary secretions are diminished, the bilious secretions are increased eliminating from the body the fat which is useless to it for the production of heat which is already in excess. Menstruation begins earlier in life and is more abundant. Less oxygen is absorbed in respiration and less carbonic acid is exhaled.

Greater intensity of the nervous system prevails in hot climates, the imagination is more active and the nerves more excitable.

Hot climates have however an enervating influence on the constitution.

Diseases produced by Hot Climates.—Hot climates are in dry seasons favourable to fevers, gastric derangements, liver diseases, diarrhœa and dysentery, these last chiefly follow the abuse of drinks and food.

Cold Climates.

Change in the Organism.—In cold climates the organism must produce as much heat as possible, because it is under conditions in which the loss is great. The appetite for food is increased, digestion even of fatty foods becomes easy, the secretion of the skin is diminished, and urine more abundant, because while the skin rests the kidneys work more actively, to eliminate the residue of the extra combustion; respiration is more complete, more oxygen is absorbed; the brain faculties are in greater repose, and the muscular system more developed.

There is in short a predominance of the pulmonary and digestive functions, and a diminution of the bilious and cutaneous functions.

Diseases produced by Cold Climates.—Congestion, consumption, pleurisy, bronchitis, rheumatism, dyspepsia, ophthalmia and chilblains, are among the principal.

Temperate Climates.

In temperate climates the health is chiefly in danger from the sudden variations of temperature which are so frequent especially in the spring and autumn. It is during these seasons that the catarrhal affections and fevers principally prevail.

Acclimatisation.

If an individual reside for a considerable time in a climate notably different from that where he originally lived his organism will undergo certain modifications. These taken together constitute acclimatisation. The transition from hot to cold countries is less dangerous than from cold to hot. The great danger of hot climates does not arise from the heat itself but from the miasmal maladies which prevail in them.

Resistance to Excessive Heat.

As we have seen, the human body is able to offer a certain resistance to external heat, thus a man may have good health at Madras, where the temperature reaches 104° Fahr. or at the Cape of Good Hope, where it reaches 113° Fahr. This resistance however has its limits, and the temperature may attain proportions incompatible with our organism.

Death by external heat.—Death is sometimes caused by external heat as when soldiers fall dead on a march, or reapers succumb in the field, through what is called sunstroke.

Death by heat may be due to: a rapid rise in the temperature of the blood; the gradual overheating of the whole body; the overheating of the nerve centres.

Resistance to Exterior Cold.

The body can also offer great resistance to cold, thus there are races of men living where the temperature is 85° Fahr. below freezing point. Children and old people have greater difficulty in resisting cold than adults.

Death by cold.—The action of the cold must be very intense or very prolonged in order to cause death. When death by cold occurs it may be due to rapid lowering of the temperature of the body or to the congelation of the blood locally in any part of the body, commonly called frostbite, death generally following this partial and local death. Movement and exercise are the best means of combating the effects of a too intense cold; sleep under the influence of cold is often fatal. The use of spirits favours the dangerous results of cold.

In the case of chilblains or frostbite the frozen part should not be brought near a fire as fierce heat tends to promote gangrene but should be rubbed with the hand or with snow, and life and heat will gradually return.

II.—LIGHT.

SOLAR LIGHT.

Light is essential to the existence of all living organisms. It is indispensable to the healthy life of man as well as to that of the lower animals and to the productions of the vegetable kingdom.

Physiological Function of Light.

If we examine the physiological action of light from a hygienic point of view, we find that it exercises an influence on the general development of the body on the vision on the intellectual faculties and on the skin.

Action of Light on the general development.—Light acts on the healthy growth and development of the body. It quickens respiration, aids nutrition and conduces to a vigorous condition of body and mind. Human beings sicken if deprived of light just as plants do and a stay for any length of time in a dark dwelling will cause the tissues to become pale and the general health to deteriorate. Artificial light cannot supply the place of sunlight as a health-giving agent but is on the contrary injurious and those who live much in an artificially lighted atmosphere become pale and sickly.

Action of Light on vision.—A too feeble light is injurious to the eyes as it causes a prolonged dilation of the pupil and may produce myopia or shortsightedness.

Too brilliant a light on the other hand especially if it strikes suddenly on the eyes, enfeebles the optic nerve and may finally destroy it. Passing from a dim into a very strong light has the same effect on the eye. People who from the nature of their occupations are continually exposed to a brilliant light are subject to cataract.

The concentration of the sight on very small or brightly illumined objects, as in using a microscope, etc., tends to produce shortsightedness.

Perfect absence of light for a short time rests the eyes, but if too prolonged though it sometimes gives sharpness to the vision often renders the eyes incapable of bearing an ordinary light.

Action of Light on the intellectual faculties.—Light exercises a marked effect on our intellectual faculties and tends to produce cheerful dispositions. Darkness rests the brain and favours sleep and is therefore beneficial at night or in the case of some illnesses but to live in dark and gloomy surroundings develops a disposition to sadness and timidity.

Action of Light on the skin.—In the dark the skin grows pale and sickly-looking; the action of light stimulates its action and renders it firm and of a healthy colour.

ARTIFICIAL LIGHTING.

Artificial lighting should fulfil two important conditions: it should give a suitable light, and should burn the products of its own combustion.

Many methods have been employed for obtaining light. These, primitive and rough at first, have by the aid of chemistry and physics been gradually brought to the perfection in which we now find them.

In early times animal fats or oils were burned by means of a floating wick in shells or cups. These methods were followed by tallow candles which as they gave off smoke and irritating vapours and yielded only an unsteady light were very trying to the sight.

The wax, sperm, and composite or parafine candles now generally used are a great improvement on tallow candles; combustion being more complete, the wick burns to ashes, and the candles while burning give off less carbonic acid.

The principal liquid substances used for lighting are animal oils, and oils of vegetable and mineral origin. The healthiness of lighting by oil depends on the degree of refinement of the oil and the perfection of the lamps. Well refined colza oil is the best of the animal oils.

Lighting by animal oil by means of a moderator lamp is convenient and healthy, the combustion of the oil being almost complete while but little of the wick is carbonised.

Animal oils are now little used mineral oils being generally preferred as they give more light. Being very inflammable however it is well to observe the following precautions with regard to them:—A large quantity of the oil should not be kept in the house at a time; the oil should be kept in metal cans well closed; lamps should never be filled while alight but prepared during the day; the receptacle should be full when the lamp is lit; in case of explosion or of fire recourse must be had to sand earth or cinders, not to water;

the oil must never on any account be used to quicken a fire.

Gas used for lighting is bicarburetted hydrogen. It gives a powerful light but consumes a great deal of oxygen and produces considerable heat; as it burns it gives off a poisonous gas which soon vitiates the air. When employed in houses or public buildings special arrangements should be made for ventilation and for carrying off the products of combustion.

When gas is united in certain proportions with air it forms a dangerous explosive. Care should therefore be taken when its presence is detected by its smell to open windows or doors and clear the atmosphere before seeking for the escape with a light.

Oxy-hydrogen gas used with lime for Lanterns gives a very powerful light but cannot conveniently be used in the interior of houses.

The electric light which is gradually being brought to perfection, threatens soon to supplant gas for lighting public halls, picture galleries, warehouses, etc.

From a hygienic point of view the electric light possesses great advantages over gas; for it does not deteriorate the composition of the atmosphere, because it consumes no oxygen and gives off no products of combustion.

Owing to its extreme brilliancy which is believed to be harmful to the retina of the eye the electric light has been considered unsuitable for the lighting of small apartments. By means however of what is known as the incandescent system, a soft and pleasing light has now been produced, and we may hope soon to see it supplanting, even in ordinary dwelling-houses, those methods of lighting which are necessarily accompanied by consumption of air.

HYGIENE OF SIGHT.

Sight is the sense by which we discern colour, form, number and distances of bodies. These bodies become visible to us by means of the rays of light reflected from them passing into the eye on the retina of which they form an image which is transmitted by special nerves to the brain.

Hygiene of sight has for its object the preservation of the eye (the organ of sight) and the perfection of its function.

Principles.

Sudden impressions of light are injurious to the eye, transitions from darkness to light should be gradual.

Intense light fatigues the eye, it is apt to produce inflammatory affections and may even occasion blindness.

Insufficient light also fatigues the eye, because of the effort the eye must make to see the insufficiently lighted objects. Longsighted people require more light than shortsighted ones as the object under observation is placed farther away from the eyes.

Artificial light fatigues the eyes much more than daylight, as it is less diffused and more dazzling on account of the predominance of red rays, while the rays which it emits are accompanied more or less by heat.

The colour of the rays of light which reach the eye is a matter of importance, blue and green rays are the least fatiguing; red and violet produce a sensation of weariness.

Protection of the organ of Sight.—The eye should not be exposed to currents of hot dry air which irritate it, nor of cold air which predispose to catarrhal affections and may bring on inflammation. All causes having a tendency to produce congestion of the head should be avoided. The state of the general health greatly influences the eyes, and in case of weakness of these organs, special care should be taken to preserve the body in a strong and vigorous condition.

The distance of distinct vision for ordinary sights is form twelve to fifteen yards. When a person cannot see distinctly at more than nine yards distance he is said to be shortsighted or myopic, if on the contrary he cannot distinguish objects clearly at less than twenty-four yards distance he is said to be longsighted or hypermetropic.

Myopia occurs when the ball of the eye is elongated from front to back, the eye is disabled for distant vision because the rays of light come to a focus before reaching the retina. This can be corrected by the use of concave glasses which make the parallel rays diverge and retards their focussing.

In hypermetropia which is a flattening of the eye-ball from front to back the rays reach the retina before they have come to a focus, this can be corrected by convex glasses which commence the process of focussing the rays before they enter the eye.

In cases of hypermetropia and of myopia glasses properly adjusted to correct the sight should be obtained and worn constantly.

Hygienic Rules.

The eyes should have frequent intervals of rest more especially if weak and feeble.

Occupations should be varied.

Every morning and evening, and after any considerable time spent in reading and writing, the eyes should be bathed with cold water.

When working or reading by lamp light, a shade should be so arranged that the eyes may be in the dark, and the work or book well lighted.

The sitting-room should be well ventilated, the air fresh and temperature equal, the light should be sufficient, but softened so as not to strike directly on the eyes.

III.—SOUND.

Hygiene of Hearing.

The vibrations of sonorous bodies produce sound, which travels through the air in sound-waves and impinging upon the drum of the ear is transmitted to the brain by means of the intermediate bones and nerves.

As with the eye; temporary repose of the organ of hearing quickens its sensibility but if the silence be prolonged this effect is destroyed. The absence of noise aids memory and meditation, but it is a common experience that it is possible to get so accustomed to certain moderate vibrations that the ear no longer perceives them.

Very loud sounds as of explosions may produce rupture of the membrane of the tympanum, the drum of the ear, or may deaden the nerve and thus cause deafness.

The intensity of the sound which reaches us varies according to the density of the atmosphere. On a clear cold day sounds are more distinctly heard than in damp foggy weather.

Protection of the organ of Hearing.—The passage of the ear, or the auditory canal, should be kept clear of extraneous dirt, but great precaution must be observed in cleaning the ear as it is a very delicate organ and easily injured. Care should be taken especially in the case of children that foreign bodies, insects, etc., do not gain entrance into the auditory canal.

The acuteness of the sense of hearing varies much in different individuals. Hearing is the sense which furnishes the greatest number of ideas to our intelligence, and contributes most to our education. It is however one of the first senses to become dulled by age.

Hearing may become morbidly acute (hyperacusic). This is often a symptom of nervousness, or hypochondria, or it may result from an injury to the auditory canal.

The paracusic state is that which is characterised by buzzings murmurings and want of clearness of perception and may arise from various causes and ill-health.

Dulness of hearing (dysœs thesia) may be acquired or congenital. When it comes on great care should be taken to put no strain on the organ. The semi-deaf often harm themselves by making too great an effort to hear.

Hygienic Rules.

To avoid injury to the organ of hearing, the ear should not be exposed to continual and excessive noise nor to loud startling sounds. Silence is often one of the most precious restoratives in the case of the sick.

In the case of children violent noise has been known to bring on convulsions.

Attention must be given to the cleanliness of the auditory canal that it be kept free of extraneous dirt, and in no way clogged by the entrance of bits of wool or fluff of cloth, etc.

IV.—ELECTRICITY.

Physiological and Pathological Action.

Positive Electricity is the electrical condition of the atmosphere in clear fine weather. This state of the atmosphere is favourable to health and facilitates the action of the various bodily organs.

Negative Electricity is the electrical condition of the atmosphere in damp and stormy weather. This condition of the atmosphere depresses the system and often produces heaviness headache and sickness.

Invalids and especially those suffering from rheumatism neuralgia ague or chronic affections feel keenly the presence of negative electricity in the air. Their symptoms are aggravated by the unfavourable electrical condition of the atmosphere.

Precautions to be taken during a Storm.

No special rule applicable to all cases can be given, but certain precautions should be taken to avoid as far as possible the dangers arising from electricity during a storm.

Buildings of any considerable height should be supplied with lightning conductors, with regard to which the following conditions should be observed: the rod must be of sufficient capacity for the easy transmission of the discharge of electricity. The principal object of a lightning conductor is to prevent eruptive discharges in the vicinity of a building, by means of a slow discharge of electricity from its various points. The number of conductors and the position of their terminal points will depend upon the size of the building the material of which it is constructed and the comparative height of its several parts. Special attention should also be paid to the provision of a proper and sufficient earth terminal.

There seems to be no foundation for the common notion that the direction of lightning is influenced by a current of air. Danger is not therefore increased by running through a storm, or by having the window of a room open.

If overtaken by a storm in the open country shelter should never be sought under a high tree as this from its isolated position is liable to be struck. The neighbourhood of churches steeples tall chimneys and of great masses of metal should also be avoided.

Assemblies of men and animals increase the dangers of lightning, because the transpiration of the lungs and skin gives rise to an ascending column of vapour which acts as a conductor of electricity more effectually than dry air.

V.—FOOD.

Food plays an indispensable part in the maintenance of animal life. By food we understand all substances taken into the body which go to repair the waste and to generate heat and consequently energy in the body. Food in this acceptation of the term therefore includes air and water.

Food has consequently an important function to perform. It must furnish materials for building up and repairing the tissues of the body which are undergoing continual waste, and it must produce heat and so maintain the proper temperature of the body and furnish it with the necessary vital force. This process of maintaining and repairing the animal economy is called nutrition; the materials for nutrition are food and air.

Constant change is the law of all organic life. The various tissues of the body having lived a certain time, die and have to be replaced by fresh tissues. When the body is in a healthy state these changes of nutrition and decay take place vigorously and rapidly and a good appetite or craving for food is the result. During the period of growth, food has not only to furnish materials for repairing waste of tissue but also for the growth and development of the body and consequently more food is needed at this time of life than at a later period. It will be clearly seen from what has been said that food is absolutely necessary to the continuance of life. Should insufficient food, or food of a nature unsuited to repair the tissues be taken the tissue will waste away and a weak and impoverished state of body will follow. If the body suffer from lack of food for any considerable length of time death by starvation must result.

Again food is needed to generate heat in the body. The body must be maintained at a constant temperature of 98° Fahr. We have already seen that heat is produced when oxygen enters into combination with different elements of food such as carbon and hydrogen. This process is one of slow combustion. The combustion which we see in the outer world is caused by the union of oxygen with the various vegetable products such as wood, coal &c. The chemical combination being rapid heat and light are evolved, but were it to take place more slowly, heat only would be evolved and not light. It is such a process of slow combustion unaccompanied by light which takes place in the body. Our bodies in fact resemble a fire the fuel of which is supplied by the food we eat and the air we breathe. We know that when death occurs and the processes of combustion no longer take place, our bodies become perfectly cold. If our bodies were deprived of food they would die, not only on account of the unrepaired waste of tissue but also because they would become cold owing to the non-generation of animal heat.

The agent which conveys the nutritive properties of food to the tissues is the blood. Food feeds the blood and the blood feeds the tissues. The tissues of the human body like those of vegetable fabrics are composed of cells. These are little membranous bags filled either with liquid or solid substances. The membrane or cell-wall is extremely thin and has the peculiar property of allowing fluids to pass through it. Thus nutrition becomes possible for the nutritive fluid can pass from the blood into the cells and from one cell to another. The blood furnishes the materials for the development and multiplication of the cells and in this way the human frame is built up and repaired.

ALIMENTARY CONSTITUENTS.

The human body is composed of certain elements, and it is evident that if food is to furnish the necessary materials for the repair and growth of the body, it must contain the elements of which the body is composed. These elements are Oxygen, Hydrogen, Nitrogen, Carbon, Phosphorus, Sulphur, Chlorine, Sodium, Iron, Potassium, Bromide, Iodine, Calcium, and Magnesium.

Oxygen is supplied principally by the air we breathe, and plays a great part as explained in Chap. XI. in the purification of the blood and the production of heat.

Hydrogen and carbon are furnished by the foods called hydro-carbonates, which are valuable on account of their heating properties.

Nitrogen enters the system with the air and with albuminous foods.

Sulphur combines with oxygen and produces sulphates which are eliminated.

Phosphorus is of great importance; it enters into the composition of the tissues, constitutes half the weight of the osseous or bony system and aids in the formation of the muscular nerve fibres and of the blood corpuscles.

Chlorine plays an important part in the organism; it is found in the blood as chloride of sodium and forms half the weight of its saline matters.

Chloride of sodium, or salt, is indispensable in food. Taken in proper proportion it aids in the work of digestion and absorption, and though taken in excess it enfeebles the digestive powers, yet absence of salt in food brings about impoverishment of the blood.

Iron has a special influence on the composition of the blood. It is found in considerable proportion in hœmatin, the colouring matter of the red corpuscles. The blood contained in the blood-vessels is reckoned to form about the eighth part of the composition of the whole body; the quantity of iron contained in the blood of an adult is from 2·50 to 3 grammes. If the proportion of iron is diminished, we retain less oxygen in our blood; it becomes impoverished, and defective nutrition is the result. Thus iron is always indicated as standing first in the treatment of impoverished blood.

CLASSIFICATION OF FOODS.

Foods may be divided into three classes.

The Reparative foods, those which repair the constant waste of tissue. They belong to all the three kingdoms of nature.

The Calorific or heat-producing foods called hydrocarbonates, because they contain a large proportion of hydrogen and carbon and generate heat; these are the sugars, starches and fats.

The third class comprises the Nerve foods, or those which act specially on the nervous system, such as alcohol, coffee and tea.

- Class A Reparative Foods
  - Mineral
    - Water.
    - Iron.
    - Salt.
    - Phosphate of Lime.
  - Vegetable
    - Legumin (peas).
    - Gluten (bread).
  - Animal
    - Albumen (eggs).
    - Casein (milk).
    - Fibrin (blood).
    - Musculin.
- Class B Calorific Foods
  - Sugars and Starches.
  - Fats and Oils.
- Class C Nerve Foods
  - Alcohol.
  - Tea.
  - Coffee.

Reparative Foods.

Mineral. Of salt and iron we have already spoken. Water is composed of oxygen and hydrogen. It acts principally as a solvent on food, and thus greatly aids the work of digestion. It is contained in abundance in all kinds of food, but in a larger proportion in vegetable than in animal substances.

Phosphate of lime is the chief element in the composition of the skeleton, and is necessary to its growth and development. If it is wanting in the food of a child rickets often result. Some vegetables, such as spinach and haricot beans are rich in phosphate of lime. It has been demonstrated by analysis that the proportion of phosphate of lime is highest in those animals whose activity is greatest and that vitality and muscular activity are augmented by the addition of phosphate of lime to food.

The remaining reparative substances, belonging both to the vegetable and animal kingdoms, legumin, gluten, casein, fibrin, albumen, and musculin, are nitrogenous substances. As a considerable proportion of the body is composed of nitrogen, it is necessary that food should contain a sufficient amount of this element, or the waste of the tissues cannot be efficiently repaired. A nitrogenous diet is the most nourishing and strengthening. Nitrogen is contained abundantly in animal substances, such as flesh, milk, eggs, and, in a smaller proportion, in vegetable articles of diet.

Gelatine is obtained by boiling tendons, ligaments, bones, etc. It is richer in nitrogen than albumen but is not rich in carbon. It is difficult to metamorphose in the stomach and therefore not easily assimilated. It can repair the tissues of its own order but cannot undergo new modifications. It is not specially nutritive therefore only suitable for those who take little exercise. Poultry and fish which contain gelatine are good food for invalids.

An almost exclusively nitrogenous diet is likely to produce such diseases as dyspepsia and gout. An insufficiently nitrogenous diet induces a general impoverishment and wasting away of the system. People who submit themselves to the grape diet or live exclusively on vegetables, roots, and bread, often fall victims to this.

Calorific or Heat-producing Foods.

These food substances are found both in the vegetable and animal kingdoms but belong principally to the first. They include starches, gums, sugars, fats, and oils.

The starchy substance found in farinaceous foods as in bread is insoluble; but when subjected to the action of saliva in the mouth, is changed into soluble dextrine and grape sugar. It is further acted upon in the small intestine by the pancreatic juice and when reduced to a soluble condition, can be absorbed by the blood and transformed into heat.

Fats are of great service in keeping up the heat of the body; the heating power of fats is twice that of starches. A certain amount of fat food is stored to form reserves for various combustions, some is at once burnt for the requirements of heat and movement, and the remainder is eliminated by the sebaceous glands of the skin. An excess of fatty matter in food is harmful in proportion as the life is sedentary and the climate hot. Dwellers in cold climates require a much greater amount of fatty food than those who inhabit warm countries.

In illnesses arising from poverty of constitution such as scrofula fat foods are beneficial, hence the universal use of fish oil.

Nerve Foods.

Nerve foods are those which produce on the organism a certain amount of excitement. They act on the nervous system of the spinal cord and through the medium of the sympathetic nervous system, exert an influence on the local circulation. Nerve foods such as tea, coffee, and alcohol, stimulate the system and give energy for work. In the universal consumption of nerve foods, we trace a need rather than a pleasure, an organic necessity rather than an animal satisfaction.

KINDS OF FOOD.

Before considering the various kinds of food, it will be well to notice the changes food substances undergo in passing through the alimentary canal.

Grape-sugar and sugar of milk are for the most part absorbed without any change. Cane-sugar is transformed into glucose. Part of the sugar is transformed by fermentation in the intestines into lactic acid and then into butyric acid.

Starch is changed into dextrine and into grape-sugar by the saliva and by the action of the pancreatic juice.

Fats are separated into minute globules by the gastric juice in the stomach, and are further acted upon in the small intestine by the pancreatic juice which converts them into a kind of emulsion. Thus prepared they are readily absorbed by vessels called lacteals which transmit them to the blood.

Albuminoids are chemically acted upon by the gastric juice and by the bile and pancreatic juice. They are principally absorbed by the blood-vessels of the small intestine.

Gelatine is also dissolved by gastric juice but without any change taking place in its chemical composition.

None of the substances of which we have spoken, taken singly would serve for the nourishment of our bodies. They can only be considered as fit to sustain the economy when united in proper proportions. We should indeed become starved although supplied with articles of diet in abundance, if the food substances chosen did not contain all the elements essential to the building up of our bodies. We see then how necessary it is from a hygienic standpoint to examine and understand the composition of the various kinds of food.

In discussing a healthy dietary variety must not be forgotten. If sufficient variety is not introduced into diet, even although the necessary elements be included, the health will suffer, for appetite will be diminished and nausea will probably result. Should it be difficult to procure much variety in articles of food, different ways of cooking the same thing will do much to prevent the evils of sameness of diet.

Where we find all the necessary substances united in proper proportions in one food, we call it a complete food. Milk is the only complete food we possess.

Foods of Animal Origin.

Milk is the first food of all human beings, and for a time sufficient alone for the nourishment and growth of our bodies.

Milk is slightly heavier than water, its specific gravity being 1·032. It contains in solution albumen, serum, casein, sugar of milk (lactin), salts, and holds in suspension minute globules of a fatty matter.

Milk is a perfect food, because it contains:—

Mineral food substances—water and salts;

Nitrogenous food substances—albumen and casein;

Calorific food substances—lactin and butter.

Milk when fresh is alkaline, but it readily becomes sour or acid and coagulates at a temperature of 60° to 70° Fahr. At a higher temperature, 95° to 105° Fahr., the sugar of milk undergoes alcoholic fermentation and produces Koumiss, a celebrated Russian drink.

When milk coagulates slowly cream rises to the top and this when churned forms butter. The serum which remains behind (water, lactin, lactic acid and salts) is skim milk. The sweet taste of milk is due to the lactin.

Milk varies according to the kind of animal which furnishes it, and according to the food of the animal. Herbivorous animals produce milk rich in lactin. Sheep on account of their wool lose little heat and store much fat their milk consequently contains a great deal of lactin. The milk of the ass is nearest in composition to the human milk; there is almost as much casein in it but a little less of the fatty element.

It has been noticed that milk, at the end of the milking, contains more fatty matter than at the beginning, and that the evening milk is richer in fat than that of the morning.

Sugar and fatty matter predominate at first in the milk of animals with young, later on the casein increases.

The quantity of milk yielded by an animal will depend greatly on the age and constitution of the animal, on the quantity and quality of its food, and on its manner of life, that is to say whether it passes its existence out of doors or is kept in sheds.

Preservation of Milk.—As milk soon becomes bad, many methods of preserving it have been adopted. It should be understood that the purer the milk is, the less quickly it will deteriorate. The material of the vessel to which milk is consigned influences its preservation; leaden vessels should never be employed, iron rapidly imparts a stringent flavour; tin or earthenware vessels are the best. It should not be changed from one vessel to another, as this accelerates fermentation. It has been stated, that by heating milk daily in a "bain-marie," it could be preserved a year. It may be preserved for a short time by the addition of a little bicarbonate of soda, or of a little lime-water. If the greater part of the water is evaporated and sugar added it may be very successfully preserved in air-tight tins.

This is the way in which the tinned milks now in general use are prepared.

Physiological Function of Milk.—Infants and young animals live entirely on milk; being a complete food, it suffices for their nutrition and growth. After the weaning time however an exclusive milk diet is no longer suitable, it gives little strength and energy. Children who are fed too long exclusively on milk become pale and puffed their cellular tissue is too much developed and their digestive organs do not acquire in time the special habits necessary for the digestion of the less easily assimilated foods which must be supplied later on. We mean by this that the digestive juices necessary to assimilate solid food are never called into action except by the presence of solid food in the stomach and intestine, and the power of forming these secretions becomes most difficult unless the habit is acquired early.

A moderate proportion of milk in diet may be employed with benefit by those who lead a sedentary and inactive life; but where great expenditure of strength is involved, as in the case of labourers, it is unsuitable as an article of food. It is impossible upon milk to maintain the necessary force which is needed for continued energetic work.

Fresh milk is easiest of digestion. Boiling deprives it of its flavour the element nature adds to it as a condiment.

Milk which contains much casein is apt to produce diarrhœa especially in children as the casein is not dissolved in the stomach. Generally however milk has a tendency to constipate and is found useful in the treatment of dysentery.

Pathological Function.—It has been said that milk may contain morbid germs, and is therefore the frequent vehicle of contagious poisons. It is true that a milkman may cause typhoid fever by adding contaminated water to his milk; but a graver possibility, which recent experiences have been thought to demonstrate, is that of the transference of tuberculosis and scarlet fever from the cow to man by the use of the milk itself.

This possibility is now fully recognised, and in a recent Act of Parliament passed in June 1890, special powers were given to the Medical Officers of Health to enable them to prevent the spread of infectious diseases due to a contaminated milk supply.

An exclusive milk regimen has shown good results in diabetes, consumption, and slow decline.

Cheese.—Cheese is coagulated milk. Cheeses differ according to the nature of the milk employed, the quantity of cream used, and the mode of manufacture.

The principal kinds of cheese are Fresh or unsalted cheeses (Neuchatel, white and cream cheeses). These are sweet and nourishing.

Salted and fermented cheeses (Marroles): the milk is treated with rennet, then strained, salted and fermented in a cellar; ammonia is formed, whence the alkaline properties which are useful in acid dyspepsia.

Dry and hard cheeses (Gruyère, Dutch, and Cheshire). Their compactness renders their digestion more difficult.

Friable cheeses produced by acid fermentation (Roquefort); in these are developed green vegetable organisms. Artificial or damaged Roquefort cheeses contain worms, and are pierced with sulphate of copper. These cheeses are exciting and produce thirst.

With bread, cheese constitutes an excellent diet much used by the labouring classes.

Butter.—Butter is obtained by churning cream and results from the agglutination of the fat globules of the milk; it always contains a small quantity of casein matter which acts as ferment, and may cause its deterioration or putrefaction. As food butter has the properties of fatty matters but is more digestible.

Eggs.—The egg is a nourishing food; indeed, we see that it must contain nearly all the materials necessary to support animal life by the fact that the chicken emerges with all its parts developed from its shell. It is not however to be compared to milk, as regards the proportions of the different alimentary properties which enter into its composition. Heating elements are wanting, although there are some traces of lactin, glucose, and fatty matters (oleine, margarine, and stearine) which are found in the yolk and constitute the oil of eggs.

The plastic or nitrogenous properties of the egg are albumen and other characteristic properties of meat, comprehended under the name of extract of meat. Eggs are easier to digest than meat, because albumen dissolves in the digestive juices more readily than the fibrin of the muscles.

The preparations which eggs undergo greatly modify their digestibility. The egg is very easy to digest if beaten up raw with water and sugar, if poached or lightly boiled, or prepared as in an omelette. When the white has become hard it is less digestible and requires more perfect mastication.

The yolk, rich in nutritive properties, is of very easy digestion; mixed with warm water, sugared and flavoured it forms a nourishing emulsion, pleasant and light.

The shell of the egg is porous, and therefore eggs must not be cooked in dirty or bad smelling water.

This porosity allows the water contained in the egg to evaporate. The weight of the egg is decreased by evaporation, and its freshness can be recognised by plunging it into a solution of salt and water: The new-laid egg falls immediately to the bottom, the staler one sinks more slowly; if three days old the egg begins to float; if five days old it remains on the surface, and the older the egg the less it is immersed.

We have said that the egg contains too little calorific matter to be a perfect food. The heat necessary for the development of the chicken germ is supplied by the mother during incubation, and in order to make the egg a hygienic food we must add to it bread, which by the sugar and flour it contains, furnishes the necessary materials for combustion.

Eggs are suitable food for invalids and children, for patients suffering from anæmia, and people of sedentary habits.

1. *Fish* forms a very useful and wholesome article of diet. Being less dense than meat, is more readily acted on by the gastric juice and therefore easier of digestion. It is therefore a suitable food for invalids, or those whose powers of digestion are weak.

Fish with white flesh such as cod, soles, &c., are easy of digestion, while those of heavier and fatter flesh, such as salmon, mackerel, &c., though more nourishing, are more difficult to digest.

Fish is less nutritive than meat, for while the flesh of beef only contains 77° of water, the flesh of fish contains 80°. Fish also contains an excess of gelatinous tissue. As a strengthening food fish therefore gives way to meat, but used in moderation it forms an excellent variety and it is specially nutritive to the brain.

Molluscs.—Oysters eaten fresh are very nourishing and wholesome. They consist of albuminoid matter, associated in large proportions with a special glycerine substance called animal starch. The flesh of the oyster contains iodine, and the sea-water which is always imbibed with them, renders the albuminous flesh easily assimilated.

Oysters are good for invalids, and for scrofulous, diabetic and consumptive patients; taken with bread and butter they constitute a complete food.

Oysters are not good during those months when they lay their spat that is to say during the hottest parts of the year.

Muscles are not quite so digestible as oysters.

Crustacea (lobsters, crabs, shrimps) have hard flesh which is difficult to dissolve by the gastric juices.

2. *Meat.*—Although meat contains all the necessary food elements of a complete alimentation, these elements are not found in convenient proportions. Meat is wanting in the materials of calorification and more especially in gelatinous properties.

The constituents of meat, taking for example fillet of beef, are as follows:—fibrin and musculin, 15 per cent.; albumen, 2 per cent.; gelatine, 2 per cent.; extract of meat and salts in a state of alkaline lactates, 3 per cent.; water, 77 per cent.; a small quantity of osmazome. Among civilized peoples herbivorous animals are preferred for food; their flesh is more agreeable to the sight and taste than that of carnivorous animals. Of mammals, the ox, calf, sheep, lamb, pig, and certain wild quadrupeds are employed.

The flesh of draft animals is wanting in nutritive properties and is especially liable to putrefaction; it is not therefore suitable for food.

The quality of the flesh of animals is influenced by their pasturage; oxen of hot climates where provender is scarce have not such a high value as those of more temperate regions. Sheep furnish wool and meat; it is not possible however to get great excellence in the quality of both these substances from the same individual. All kinds of sheep are eatable, but the quality of the meat will depend on their food and location.

Pork is much used for provisioning ships and forts. It is difficult to digest because of the fatty matters it contains but it is a great restorative and is largely employed by labourers and peasants.

Among the diseases which render the flesh of animals unfit for food are: anthrax in cattle and sheep, measles and tuberculosis in cattle and pigs, and trichinosis in pigs.

Of birds we utilise four kinds of domestic fowls for food, which may be ranged in the following order according to their decreasing digestibility—fowls, turkeys, ducks, geese.

The meat of poultry has an agreeable taste, especially when roasted; it is easy of digestion.

Feathered game (partridges, grouse, &c.) have flesh rich in fibrin and very nourishing.

The turtle is the only reptile we use as food, from it is made turtle soup, which is indigestible.

The conditions affecting the quality of meat used as food are:—

Age.—In adult animals fibrin predominates, while the gelatinous tissue is found in greater quantity in young animals, hence the whiteness of their flesh, so remarkable in veal. The meat of an animal however which has attained its full growth is more nourishing and digestible, and for this reason beef and mutton are to be preferred to veal and lamb.

Sex has an influence on the nutritive qualities of meat; males have a harder and more resisting flesh than females. The reason why the flesh of the ox is better than that of the cow may be because the latter is not killed for consumption till late in life.

Work and Fattening.—Work increases the fibrous part of the meat. Fattening should not take place till the muscular system has been sufficiently developed by exercise, or the fat will be in excess of the lean. The quality of an animal depends upon the thorough mingling of the muscular and fat tissues.

Parts of the body of an Animal.—The different parts of the body of an animal offer very different qualities of meat from a nutritive point of view. We may make three divisions according to the relative value of the different parts of an animal.

In the first division we put the rump, steaks, shin, sirloin, fillet. These are the thickest muscles, the best interleaved with fat and with fewest tendons; they represent about 30 per cent. of the net weight of the animal.

The second division includes the muscles of the shoulder and of the ribs, that is to say the shoulder-blade, the collar, the side and the flaps of the sirloin; these represent about 25 per cent. of the net weight.

In the third division are ranged the muscles of the neck and head, the muscles of the lower part of the limbs and the tail, constituting about 40 per cent. of the net weight.

There is very little carbonaceous matter in lean meat and we should supplement it with bread, potatoes, &c., in which carbon dominates; in fat meat, on the contrary, the carbonaceous matter is in excess.

After the muscles, may be mentioned, according to their decreasing nutritive value, the brain and sweetbreads, suitable for delicate stomachs, the liver which contains much fat and glycerine matter and is very indigestible, the kidneys, an alkaline diet, often recommended to dyspeptic people, the lungs or lights which have very little nutritive power. Tripe and calves crow are chiefly glutinous.

Preservation of meat.—Meat should not be eaten when newly killed. The warm flesh of an animal that has just been killed is alkaline, as it cools an acid reaction is set up and it becomes tender, by reason of the action of this acid on the fibres.

Under favourable conditions meat may be preserved some time, and longer in cold than in hot weather.

To preserve meat, it is necessary to touch it as little as possible with the hand, not to crush it, to protect it from the rays of the sun, and to keep it in a cool, but not damp, place where fresh and dry air is always circulating. It must be guarded from flies and other insects by the aid of pepper and salt, or by placing a gauze over it. It is better to hang meat than to lay it. The atmosphere of cellars is generally damp and unfavourable to the preservation of meat. Care should especially be taken to avoid the neighbourhood of all kinds of unhealthy emanations. Frozen meat when brought into a warm place goes bad very quickly. The methods for the preparation of meat are numerous and we must refer our readers for information on this subject to works on Domestic Cookery. We shall only notice here some of the modes of preparing meat which greatly affect its digestibility.

Grilled meat and underdone meat are nourishing; rapid cooking coagulates the albumen on the surface and the juices cannot escape.

Roast meat requires great care in cooking, that it may be well done without being dried and burnt, and so rendered innutritious.

Meat stewed, or fricassed, forms nourishing ragouts; but these are generally difficult to digest, because of the fat which enters into their composition. Stewed meat however if not fatty, and if cooked slowly, is easy of digestion, as slow cooking softens the fibres and thus renders them capable of being more easily dissolved by the gastric juice.

Boiled meat loses in the water the osmazome or salts which give it its flavour and the thinner the meat the more it loses. Boiled meat is less digestible than roast meat. It is less nourishing in proportion to the quantity of water used and the time it has taken to boil.

Beef tea is a valuable food for many reasons: it is absorbed without any work of the digestive apparatus; it stimulates the appetite of invalids by its agreeable flavour; it excites the secretion of the gastric juices, often interrupted in illness. Beef tea, however, contains but little nutritious matter, and only a small proportion of calorific fat or of dextrine properties. It is often over-rated, and although useful as a stimulant, it will not do to imagine that we can repair all the losses of the system and grow strong upon any quantity of beef tea or extract of meat.

Physiological value of meats.—To repeat shortly what we have already said: Fibrin and albuminous matters are digested in the gastric juice, fats in the intestines; thus the fatter the meat the more difficult its digestion.

The more flavour a food possesses the easier it digests, as we find by game and the flesh of adult animals. Tender and underdone meats are also easy of digestion. Density of structure is one of the principal conditions regulating the digestibility of foods. The less dense the substance the more easily it can be dissolved by the gastric juice. For this reason fish, fowl, and game are more easily digested than butcher meat.

Meat, by itself, would form an extravagant and unhygienic diet. It requires the addition of bread and vegetables.

Pathogenic Conditions.—If too much meat is taken, and thus a superabundance of albuminous matters introduced into the system, plethara, constipation, gout, &c., results. If a sufficient quantity is not supplied diarrhœa, anæmia, dropsy, follow.

When meat is bad, it produces different symptoms, according to the nature of the decomposition. The taste of putrid meat causes an instant disgust, which ought to suffice as warning. If taken into the system it causes nausea and vomiting, diarrhœa, fever, and blood poisoning.

Diseases may be communicated to man by the flesh of diseased animals used as food, therefore meat, sold for consumption, ought to be under strict supervision.

Characteristics of good meat.—The fat should be abundant and firm, of a white or fresh butter colour; fat which is yellow, oily, greyish, or dotted with red, is to be regarded with suspicion.

Meat must be uniform in colour, of a darkish red in beef and mutton, white in pork, veal and lamb. It must be free from disagreeable smell, must be firm and elastic, not retaining the impression of the finger, easy and clean to cut. Sections made across the directions of the fibres expose muscular bundles of smaller or larger diameter, this is called the grain; on this red ground are seen greyish dots, more or less numerous, according to the degree of fatness; these dots, formed by the fat which surrounds and penetrates the fibre, give rise to the spotted appearance of meat.

Dark coloured meat, or meat spotted with brown or black, soft meat and sticky meat are bad and should be rejected. It may happen that the black discolouration is only superficial which is the case when fresh meat has remained exposed to a draught. An incision will at once prove whether under this layer the colour is normal.

Hygienic Rules.—The quantity of meat consumed should be in proportion to the expenditure of strength. It must serve to maintain the temperature of the body and to furnish material for muscular work; it must also be sufficient to meet the needs of restoration.

Foods of Vegetable Origin.

Foods derived from the vegetable kingdom may be divided into three groups.

These comprise grains, buds, fruits, roots, young sprouts and leaves.

Grains.—The grains used as food are numerous, but they have a certain unity of composition which allows of their comparison with milk. They contain, in different proportions, the substances of which we have already spoken, albumen, sugar and fat, and, in some, there is a characteristic substance, *gluten*, formed of a mixture of albuminous gelatinous matter. The principal salts found in grains are the alkaline phosphates, more especially those of potash and also chorides.

These may be divided into oily and feculant grains.

Oleaginous grains.—Of these we may name cocoa, almonds, hazel nuts, walnuts, acorns, olives.

The trees which produce these grains grow principally in southern countries and store in their fruit the heat furnished by solar radiation.

Although rich in alimentary matter, they form but an unimportant part of food. The most useful is cocoa, the composition of which is typical. It contains albumen 17 per cent., theobromine 1 per cent., fatty matters 50 per cent., gum, starch and cellulose, &c., 25 per cent., water 4 per cent., mineral matter 3 per cent. These are the properties of milk, but the sugar matters are wanting and these are added in the manufacture of cocoa. There is also generally the addition of some flavouring such as vanilla which facilitates digestion.

Cereals.—The most important cereals are wheat, rye, barley, oats, maize and rice.

Gluten and starch are variable quantities in these cereals and generally found in inverse proportions. Wheat, rye and barley contain much gluten and very little starch, while rice and maize contain much starch and little gluten.

The varieties of flour made from wheat, rye, barley, oats and maize form one of the most important constituents of food among civilized peoples.

Wheat is the most useful of all the cereals as it contains nitrogen in the form most easily assimilated and forms so to speak a transition between the animal and vegetable kingdoms. The mixture of gluten and starch which exists in wheat flour seems to be just that which is most generally useful to man.

Oats are very rich in fatty matters and are much employed in the fattening of animals.

Maize has the same properties, 7 to 8 per cent. of its weight being fatty matter.

Rice contains much starch and little nitrogen. It is wanting in fatty matters and mineral salts. It requires the addition of meat or fat to constitute a nourishing diet.

Bread is made chiefly from the flour of wheat and of rye. It is a most useful aliment but must be taken with meat to constitute a complete and restorative food. If eaten new or if it is heavy it is indigestible, as it forms a pasty substance in the mouth which is not readily dissolved by the saliva.

Coarse bread, such as rye bread, brown bread, &c. contains a certain quantity of cellulose and ligneous tissue which is not easily absorbed and which stimulates the action of the intestines. These varieties of bread are therefore useful in cases of constipation.

SEEDS AND VEGETABLES.

Peas, haricot beans, broad beans and lentils are the farinaceous vegetables most in use. All these seeds are rich in nitrogen but contain little carbon. We must therefore add to them fat substances, such as butter, mutton, pork, &c. Peas contain the most starch, haricots the largest proportion of nitrogen and fat, while broad beans contain a considerable amount of water and salts.

The nitrogenous matter of these vegetables (legumine) is soluble in water; but salts of chalk which are generally found in water act upon it and transform it into a hard and indigestible body. In cooking such vegetables as peas, care should be taken not to use water charged with salts of chalk; rain water is excellent for the purpose. Hot water evaporates legumine, and to avoid this danger the vegetables should be put into cold water and warmed very gently. Leguminous vegetables when peeled are easy of digestion, but if the water has hardened them they are apt to cause flatulence. Healthy people however may take them without danger and for the poor who cannot afford much meat, they would form a valuable diet on account of their nourishing properties.

The Potato is a most useful vegetable, and forms an excellent accompaniment to meat. It ought however not to be employed by itself as food, as it has small nutritive value, being less nourishing than the leguminous vegetables or than the poorest of the cereals. We should have to eat about three pounds of potatoes to obtain a grain of fat. It has an advantage however over the cereals on account of its easy cultivation. It keeps well is agreeable to the taste and is easy of digestion. Taken with meat it is most valuable, as it prevents the dangers of an over-nutritious diet.

Fruits.—Although possessing little nutritive value fruits form an important article of diet on account of the mineral salts they contain. These are alkaline in character and aid in the assimilation of the nitrogenous materials and of the fats and sugars; for this reason fruits are useful in gout, diabetes, &c.

Herbaceous Foods.—Green vegetables contain a considerable amount of nitrogen and carbonaceous matter and salts which vary in quantity. The organism of man is not suited to this food exclusively, as a much larger quantity would have to be taken in order to obtain the requisite amount of nourishment than the digestive apparatus could cope with, consequently it would be rejected almost untreated. Taken in due proportion green vegetables are most wholesome and prevent constipation by the residue they leave in the intestines. Like fruit they are particularly valuable on account of the universal salts they contain. The entire omission of fresh fruits and vegetables from food almost invariably results in the disease known as scurvy.

Condiments.

Condiments are those substances which are used to flavour food, such as vinegar, mustard, pepper, and salt.

Vinegar has an influence on the composition of the blood. Taken in moderation it may serve to stimulate the appetite. An excessive use of vinegar is most prejudicial to health, as it enfeebles the digestive organs and interferes with the processes of nutrition, thus causing emaciation. Serious consequences have often followed the use of vinegar by young girls as an antidote to fatness.

Condiments when used moderately aid digestion, as they stimulate the secretion of the salivary and intestinal glands. They are therefore specially valuable in hot climates, where digestion is sluggish. Their abuse however is dangerous, as they easily produce gasteralgia and intestinal maladies.

Nerve Foods.

Under nerve foods are classed alcohol, tea, coffee.

These foods have a stimulating and restorative effect on the nervous system. Some are also believed to retard the decomposition of the tissues of the body. Under their influence, other things being equal, less carbonic acid and urea are produced.

Alcohol may be taken as a typical nerve food. Its physiological effects are as follows :—When taken into the system it causes at once a feeling of comfort and exhilaration, probably caused by its action on the nerves of the stomach ; the heart at first beats more rapidly and respiration is quickened. Taken in small quantities it seems to aid digestion but in greater quantities it checks it, as it irritates the mucous membrane of the stomach and lessens the secretion of the gastric juice. We shall consider later on the effects of excess of alcohol in the system.

Tea and coffee stimulate the nervous system. If taken in large quantities they produce nervous tremors. Their action on the heart and vessels resembles that of alcohol.

Taken moderately nerve foods render the organism capable of performing a considerable amount of work on a relatively slight alimentation. Excess of nerve foods however rapidly weakens the system and destroys the health.

COMPLETE ALIMENTATION. REGIMEN.

A hygienic regimen is one which will include those foods most suited to develop the constitution and to maintain the body in health.

Food, as we have seen, has to supply the continued losses of the economy. These losses are of two kinds, nitrogenous and carbonaceous. The losses sustained by the body will vary according to conditions of repose, exercise, age, sex and climate.

Basis of Alimentation.—An adult man loses at least 20 grains of nitrogen a day and should consume 310 of carbon. These elements must therefore be supplied to him and they can be found either in the vegetable or animal kingdom. An exclusively vegetable diet is however not to be recommended, as in order to obtain the amount of nitrogen needed, a man must take a very large quantity of food, and thus impose unnecessary work on the digestive system. An exclusively animal diet is equally objectionable for in order to gain the requisite amount of carbon, he would have to consume an abnormal quantity of meat, quite incompatible, under ordinary circumstances, with the maintenance of health. The mixed diet, to which inclination leads us, is the best suited to our constitutions, and especially adapted to our temperate climate.

Imperfect Alimentation.—Alimentation may be imperfect in quantity or quality. It may be insufficient or excessive. If insufficient the tissues of the body will waste more quickly than they are restored, as the gain of the body will not keep pace with its losses, and it will become weak and enfeebled. Should food in excess be taken, it will produce various painful disorders of the digestive system.

Quality of food.—Non-alimentary substances when taken as food cause serious irritation of the mucous membrane of the stomach. This is a danger to be apprehended from the substances sometimes used in the adulteration of food.

Regularity of Meals.—Meals should be at fixed hours; irregularity in meals and the haste with which they are eaten are frequent causes of dyspepsia. Starchy foods require special mastication in order that they may be submitted to the action of the saliva; nitrogenous and fat foods are therefore to be preferred by those who can only give a limited time to their meals.

Intervals between meals are necessary in order to allow time for the work of digestion. Food is not allowed to pass from the stomach into the intestines until it has been reduced to a semi-liquid condition. It takes two or three hours to attain this result. Intervals of three to four hours should therefore be allowed between each meal. Naturally the quantity of food taken makes a considerable difference. In the case of invalids who can take very little at a time, food should be administered much oftener.

Individual habits.—The digestive power varies much with each individual, so that no invariable rule can be laid down. The tastes and feelings of the individual should always be consulted.

Influence of Exercise.—It has been truly said that we digest as much with our legs as with our stomach; thus we find dyspepsia a more common complaint among the rich than among the poorer and more active classes. Over-exertion after a meal stops digestion, but absolute inactivity renders it very slow.

Influence of Oxygen on Digestion. Fresh air and sea breezes which supply our lungs with a sufficient quantity of oxygen and ozone, promote digestion and increase the appetite. Respiration of the unwholesome air of towns and of crowded dwellings, renders us liable to dyspepsia. Plenty of outdoor exercise is the best safeguard against dyspepsia.

Digestion is often impeded by over-excitement and by tight clothes, especially by the use of corsets, which will be referred to in Chapter VIII.

Hygiene of Taste.

Taste enables us to appreciate the properties of different substances and indicates to us the needs of the stomach. The stomach rarely rejects substances which the taste accepts. We should be careful not to injure the sense of taste, for it has a direct physiological use. Very strong flavours will have a stimulating effect on it for a time, but will in the end deaden its sensibility. In order to preserve intact the sense of taste, we must abstain from anything which will exhaust or lessen the secretion of mucous saliva, and also from anything which will deaden or irritate the organs employed in forming the taste, on this account we should not indulge in the use of strong alcoholic drinks, the chewing of tobacco, smoking, or the use of acid bitter or pungent condiments.

Hygiene of the Sense of Smell.

The sense of smell completes the sensations imparted by taste and sometimes supersedes them. This sense warns us of any vitiation of the air we breathe and is therefore of special value. Strong odours in a confined space will cause headache and faintness, and will in time weaken and destroy the sense of the olfactory organ. Sometimes they are useful as a stimulant, as in cases of asphyxia and syncope, when the patient is made to inhale salts and vinegar. When we become accustomed to a certain smell it passes unobserved. All circumstances which injuriously affect the pituitary membrane render the perception of odours less distinct, as for instance a cold in the head.

Tobacco taken as snuff rapidly weakens the sensibility of the pituitary membrane. In fact the use of tobacco in any form is injurious to the health and when taken in excess, it is the cause of many serious diseases.

Smoked, tobacco irritates the mouth, the stomach, and the larynx, and at the same time it affects the secretion of the saliva and of the gastric juice. It causes palpitation, and the pleasurable excitement which it at first produces soon gives way to a nervous depression which acts most injuriously on the whole system.

Chewed, tobacco produces diseases of the stomach and chest while at the same time it acts as a narcotic poison and deadens the intelligence.

Hunger and Thirst.

The sensation of hunger has its seat in the stomach, but it is indicative of the wants of the system at large. When sufficient food is introduced into the stomach the sensation ceases. Prolonged fasting will also dispel these sensations, probably owing to the weakening of the nerves of the stomach.

Thirst.—The sense of thirst is referred not to the stomach, but to the fauces or back part of the mouth. It indicates the need of water in the system. The sensation of thirst is much more difficult to endure than that of hunger. Deprivation of liquid soon becomes a terrible torture, causing violent delirious fever, due probably to acute gastric-enteritis.

BEVERAGES.

Water enters largely into the composition of the human body; it forms 80 per cent. of the blood and fully 75 per cent. of the muscular tissue.

Water is essential to digestion, it is by its aid that the various chemical changes are affected by which solid food is dissolved and rendered capable of absorption into the system. An average adult requires from 80 to 100 ozs. of liquid daily, taken either as pure water, or in tea, coffee, milk, or combined with solid food.

The water of the blood is not only the vehicle for bringing to the tissues the materials necessary for their development, but it also takes up the products of their decay, and conveys them by a wonderful system of sewerage out of the system. Water, charged with these products, is eliminated in various ways; it is expelled from the lungs with the air, it is excreted by the skin in the form of perspiration and is given off from the kidneys in the form of urine.

Action of Alcoholic Beverages on the System.—Alcoholic beverages if taken in moderation and especially with food, seem useful for some constitutions. People whose digestion is feeble and circulation languid may be benefited by them. The dietetic value of alcohol is probably however much over-rated. In health, it is certainly not a necessity and many people are much better without it.

Alcoholic stimulants afford a pleasant sensation owing to the warmth they produce all over the body and to the stimulation of the nervous system. There is a danger on this account of a habit being formed of recurring to them again and again; this may easily degenerate into a vice which will bring on ruin of the digestive system and cause premature disease and death. Alcohol taken in large doses irritates the mucous lining of the stomach and paralyzes the action of that organ and arrests digestion. The liver is much affected by it, hence the frequency of liver complaints among spirit drinkers. Alcohol increases for a time the vital activity of the body but this soon passes off and a period of depression follows. When used habitually in excess it produces a morbid condition of the body and particularly of the nervous system. As it tends to prevent the due performance of the work of the excretory organs, the products of decay, left in the system, produce a condition of blood which is peculiarly favourable to infectious disease. The nervous system and the intellectual faculties are particularly affected by excess of alcohol. The brain has a special affinity for it, and when taken in excess it has been found in considerable quantities in the substance of the brain. Paralysis, trembling, mania, weakening of the intellectual faculties, result from the excessive use of alcohol.

The best means of doing away with the terrible abuse of alcohol is to improve the conditions of life amongst the poorer classes, by securing for them more wholesome living and more comfortable homes. It is also specially important to provide some efficient safeguard against the adulteration of alcoholic beverages.

Wine is more of a food than any other alcoholic drink, as it contains more nitrogenous matter. Bordeaux is a good tonic for invalids and people with delicate stomachs. Burgundy is a better and more stimulating wine; sparkling wines influence the nerves by reason of the carbonic acid they contain.

Beer is generally described as an infusion of malt, flavoured with hops, but in fact sugar often takes the place of malt, and other bitters the place of hops. It is named small beer, ale, porter, stout, lager beer, etc., according to its strength and other qualities. Beer, owing to its bitter aromatic qualities, is a slight tonic and it is nutritive according to the percentage of sugar and albumen which it contains.

Light beer is easy of digestion; strong beer is heavy, and although nourishing, is often the cause of dyspepsia and obesity.

Hygienic Rules.—The use of alcoholic drinks even in moderation should be absolutely forbidden to individuals of a plethoric disposition, or to those of nervous irritability of temperament.

ADULTERATION OF FOOD AND DRINKS.

Food may be adulterated by the addition of some foreign matters, usually of an inferior but often harmless character, or by the subtraction of some of its nutritious qualities.

Milk was formerly much adulterated by the subtraction of some of the cream or fatty matters, but government has recognised the importance of this article of food, especially to the poor, and it is so carefully watched that adulteration is not now so frequent.

Butter is adulterated to a large extent with fecula of potatoes, but this mode of adulteration is readily discovered by melting a little of the butter, when the fecula will settle at the bottom.

Until quite recently margarine was often sold in the place of butter. This product is made of a mixture of stearine, margarine, oleine and other fatty matter. Sometimes oil of arachis is used in its manufacture to prevent it setting hard on the palate or lips. Margarine is more difficult to digest than butter, and has less nutritive value.

Olive Oil is adulterated with oils of inferior quality, such as walnut oil, and oil made from poppy heads. The taste is sufficient to prove its adulteration.

Flour and Bread.—Sometimes alum is mixed, in small quantities, with flour, to give it a white appearance. Ground rice or beans are also often added to flour.

Sugar.—Chalk and sand are sometimes mixed with powdered sugar. This adulteration can be detected by melting some of the sugar in water, when the sand or chalk will sink to the bottom.

Sweets.—Very often injurious effects are caused by the poisonous substances used in colouring sweets.

Coffee, when ground, is very easily adulterated. The best means of detecting the presence of any adulteration is to scatter a little coffee on the surface of some water, if the coffee is pure it will float some time before sinking and when it does sink will leave the water a yellowish colour, but, if adulterated it will sink almost immediately leaving the water brown. It is impossible to make a paste out of coffee, if pure, but, if adultered with fecula, a paste is easily formed.

Pepper.—Ground pepper is adulterated by various substances, such as rice-powder, crushed maize, oil-cake and sand.

It is generally necessary in order to discover these adulterations to resort to chemical analysis and the use of the microscope.

Tea is adulterated sometimes by the grower, and sometimes by the salesmen. The chief modes of adulteration are colouring it artificially using other kinds of leaves than those of the tea-plant, and re-employing leaves that have already been used. Green tea is more often adulterated than black.

Wine is of all things most easily adulterated and there are many methods employed. The most usual way is by the addition of water. Sometimes perry and cider are mixed with it while alcohol is not unfrequently added to give it a richer taste and appearance.

Tithage is often employed to diminish the greenish appearance of certain wines and to give them the colour of old wines. This lead-salt, even if taken in the smallest quantities, is very poisonous.

Treacle, sugar, acids, alum, sulphate of iron and colouring matters are also used in adulterating wine.

Beer.—One of the most common modes of adulterating beer is to substitute fecula sugar for barley, by doing which the beer is deprived of its nutritious properties. Brewers have often tried, but without success, to find a good substitute for hops. Box-tree leaves and picric acid have been tried, but have failed on account of their not acting as a tonic, nor as an excitant to the nervous system. Strychnine, a deadly poison, has also been employed.

Beer is very apt to go sour, and when sour it attacks such metals as lead, zinc, and copper. Metal storage tanks and leaden tubes should therefore be prohibited in breweries, for metals, when worked on and dissolved by the action of the beer, affect it very injuriously.

Chalk potash and magnesia are often added to beer to prevent it turning acid or to neutralize its acidity.

Vinegar.—Vinegar is often adulterated with acetic acid. Sometimes it is mixed with water and when weak is strengthened with sulphuric, nitric, oxalic, or tartaric acid. It is flavoured by the addition of mustard, pepper and inferior wine, with which a little alum is often added. When too thin, it is given more substance by the addition of salt, acetate of chalk, and sulphate and acetate of soda.

VI.—THE EXCRETIONS.

Excretions are the waste or effete matters which must be expelled from the system.

It is of great importance that the excretory organs should be kept in good working condition, as any accumulation of waste substances in the body is most injurious to the health.

The functions of secretion and excretion are accomplished by the lungs, the digestive system, the kidneys and the skin.

As we shall speak more particularly in Chapter XI. of the excretions of the lungs, we shall only consider here the excretions from the digestive system, the kidneys and the skin, noticing in the first place however the buccal excretions, or excretions of the mouth.

BUCCAL EXCRETIONS.

Buccal excretions consist of buccal deposits, formed of the waste epithelium of the mucous lining of the mouth, and of a deposit of dental tartar, due to a mixture of mucous and of phosphate and carbonate of chalk.

Hygiene of the Mouth.

Number of Teeth.—If any teeth are missing they should be replaced by artificial ones; if on the other hand they are over-abundant and irregular, one or two should be extracted to allow the others to grow properly.

Dental Concretions.—Care should be taken to prevent the accumulation of tartar on the teeth, as it is apt to cause the gums to ulcerate, the teeth to decay, and the breath to smell unpleasantly. The digestive organs should be kept in good working order, as it has a great effect on the purity of the breath and the condition of the teeth. The teeth, on the other hand, affect the digestive system, as without good teeth, mastication cannot be properly performed.

The teeth should be cleaned night and morning in warm water, and the mouth should be rinsed, and all particles of food be moved from the teeth, after every meal. Soft tooth powders, such as charcoal, coral, chalk, &c., should be used to destroy the tartaric acid, but tooth powders containing acid must be avoided, as they tend to soften the enamel of the teeth.

Biting or tearing anything with the teeth is injurious to them. Taking a cold drink immediately after a hot one is apt to crack the enamel. Indulgence in too many sweets is a frequent cause of the decay of teeth among young people, as the consumption of too much sugar produces acidity of the stomach; this acts on the saliva and injures the teeth.

Smoking will also turn saliva acid. In a healthy condition saliva is alkaline, but when acid, it has a softening influence on the teeth.

THE DIGESTIVE SYSTEM.

The alimentary canal is composed of the mouth, the œsophagus, or tube leading from the throat to the stomach; the stomach a membranous bag, and the intestines, coiled tubes, the first of which is called the small, the second, the large intestine. When liquid food is swallowed, it is capable of being readily absorbed by the blood vessels of the walls of the alimentary canal. It will be readily seen therefore that solid food must be submitted to some chemical change, before it can serve for the purpose of alimentation. To effect this change, various parts of the alimentary canal are furnished with glands, capable of secreting certain fluids which exert a chemical influence on solid food, and reduce it to such a condition that its nutritive properties can readily pass into the blood. The digestive fluids are saliva, gastric juice, the pancreatic fluid, the bile, and the intestinal fluid.

Saliva is secreted by the six salivary glands of the mouth. It is an alkaline fluid and exerts a chemical action on the insoluble starch of food, changing it into soluble dextrine and grape sugar. It moistens and softens the food during mastication, and so prepares it for the action of the gastric juice.

Gastric Juice is secreted by small glands in the walls of the stomach and is poured forth when food is introduced into that organ. It contains lactic acid and a peculiar substance known as pepsin, and acts on the albuminous constituents of food. Experiments have shown that it will dissolve meat, etc., at a temperature similar to that of the body 98° Far. It brings fatty matters into a minute state of division, but has no influence on starchy and saccharine foods.

Pancreatic Fluid.—The Pancreas is a gland of considerable size, which pours its secretion, by a duct, into the small intestine. The pancreatic fluid is alkaline and strongly resembles saliva. It completes the action of the saliva on starch and reduces fatty matters to a state of emulsion.

Bile is secreted by the liver, a duct from which enters the small intestine close to the pancreatic duct. Bile aids in preparing food for absorption and also acts as a stimulus on the intestinal canal, promoting its action and the excretion of food.

Intestinal Fluid.—This is supplied by numerous small glands situated in the mucous membrane of the small intestine. United with the fluids before mentioned it acts as a universal solvent and completes the process of reducing food to the liquid condition necessary for absorption.

Process of Digestion.—Food is masticated by the teeth, and being mixed with saliva is reduced to a pulpy mass, while the starch of the food is changed into grape sugar. It is important that mastication should be thoroughly performed, so as to subject all the food to the action of the saliva. It is then conveyed down the œsophagus to the stomach. When food enters the stomach it is subjected to a sort of churning process, caused by the movements of the muscular walls of this organ. By this means food is brought into contact with the mucous membrane of the stomach, and becomes impregnated with gastric juice. The gastric juice dissolves the albuminous matters, and reduces the fats to minute globules. When food has been brought by the action of the stomach to the liquid condition called chyme, it passes through the opening, known as the pylorus, into the small intestine. Here the chyme becomes mixed with the bile, and with the pancreatic and intestinal juices. These act upon the starches which have escaped the action of the saliva, bring the fats into a state of emulsion, and render the whole fit for the process of absorption.

Absorption is carried out by the blood vessels of the alimentary canal, and by special vessels known as lacteals, situated in the walls of the small intestine. The latter absorb more especially the fatty elements, which they afterwards transmit to the blood. The liquid absorbed by the lacteals has a milky appearance, owing to the fatty matters it contains. It is composed of albumen, fibrin, fatty matter and salts, including iron, elements required for the nourishing of the blood. Food is propelled along the intestines by the peristaltic or wave-like motions of their walls, due to muscular contraction and relaxation. While this process takes place all the nutritious elements are absorbed, and by the time food has passed half-way down the large intestine, nothing but the non-nutritious part remains. This is known as fæces, and is finally expelled.

ALVINE EXCRETIONS.

These are composed of the non-nutritious parts of food; vegetable matter leaves the greatest quantity of indigestible material. The character of the excrements varies according to the constitution, age, and mode of living of the individual. By the excreta, the state of the digestive organs can be readily ascertained. Constipation is chiefly the result of the want of a proper irritant in the stomach, and of the inactivity of the digestive system. To rectify this, more vegetable matter should be consumed, and plenty of exercise in the open air taken. Exercise acts much more efficaciously than drugs in bringing the abdominal muscles into play.

URINARY EXCRETIONS.

The urinary organs are the kidneys; these secrete urine from the blood. The kidneys are composed of glands which unite with a common tube or duct down which the urine passes into the bladder from which it is expelled when necessary. Urine is water, holding in solution certain salts, and containing a quantity of urea which is composed of ammonia and carbonic acid.

The urinary excretions are modified according to age, sex, &c. Children excrete a much larger quantity of urea, in proportion, than adults. The bladder should be emptied with regularity to keep it in good condition. If urine remains in the bladder for any length of time it gives the calcareous matter time to settle and become solid, and serious consequences may result.

In fact, too great stress can hardly be laid upon the necessity of the cultivation of regular habits with regard to the excretions. Young people, through carelessness in this respect, often bring on constipation, with all its attendant evils, and many other distressing ailments which prove life-long sources of trouble.

CUTANEOUS EXCRETIONS.

The principal excretions of the skin are perspiration, perceptible and imperceptible, sebaceous or fatty matter, epidermal matter, as the waste cells of the epidermis and of the hair and nails.

As we have already seen the skin, by the action of the sweat glands, acts as a respiratory organ, and regulates the temperature of the body. We can pass now to the consideration of the hair, feet, hands, and conclude with the hygiene of the cutaneous surface of the body describing the use of baths, lotions, and cosmetics.

Hygiene of the Hair.

The hair should be cut regularly, as cutting invigorates and strengthens it.

The skin of the head should be kept clean, scurf being removed by thorough brushing and washing. At the root of the hairs are minute glands called the sebaceous glands which secrete fatty matter. When the hair is brushed the oily matter from these glands is drawn down along the hairs, and causes the glossy appearance imparted by brushing. This natural oil of the hair will usually be found sufficient, and it is better not to apply grease unless the hair is very dry and stiff.

In the case of hair falling from the head, the result of certain illnesses, some aromatic preparation containing cantharides may be used to hasten the new growth, while a diet of substances which contain a good deal of sulphur, such as eggs and vegetables of the cruciferous order, will be found beneficial.

Hygiene of the Feet.

The feet should be often washed in warm water to keep them free from dust and perspiration. Should they be apt to perspire too freely, boracic acid, dissolved in the bath, or in the form of a powder shaken into the stockings, will be found a useful remedy.

The toe-nails should be cut square, not round, if cut round the nail is apt to grow into the flesh and cause much suffering.

Hygiene of the Hands.

The skin should be kept as soft as possible to preserve the sense of touch. When the skin is liable to become hard, or cracked, the hands should be well washed at night in hot water, and glycerine thoroughly rubbed in. The nails should be allowed to grow long enough to protect the sensitive ends of the fingers.

Hygiene of the Skin.

The skin is formed of several layers, the upper of which is called the epidermis. The epidermis is composed of layers of cells and is of considerable thickness. Fresh cells are continually forming at its base, the upper layers get pushed to the surface; are flattened into scales which become dry and hard and peel off. In this way the epidermis is constantly being renewed. Under the skin all over the body are found the sebaceous glands, from which an oily matter exudes through the pores of the skin which prevents it from being dried and cracked by the action of heat and air. It is on account of this oily exudation of the skin that we are obliged to use soaps, as water alone will not remove the oil. Frequent washing with soap and water is therefore necessary to health, in order to remove the waste epidermal scales, the fatty matters and the dirt which would otherwise accumulate on the skin and hinder its functions.

Baths.—Bathing is one of the best means of invigorating and strengthening the body and of stimulating the action of the skin.

Natural Baths.—River and sea baths are very beneficial to health if care be taken not to remain too long in the water.

The effect of entering a cold bath is to cause the blood to flow from the surface of the body towards the heart, the temperature is thus lowered, circulation becomes slower, and difficulty in breathing is experienced. After this comes the spontaneous reaction, caused by the heart beginning to beat more rapidly. While this lasts, and the bather still feels warm, he should leave the water, as the effect of the reaction will soon pass off and he will become chilled. When bathing is accompanied by movement in the water, as in the case of swimming, warmth can be better sustained and the period of bathing may without danger be prolonged.

After coming out of the water a good hard rub with a rough towel quickens the circulation and renders the reaction more complete.

Sea bathing is more beneficial than river bathing owing to the sea water having a more regular temperature, while by its continual movement it produces a sort of massage on the body, and at the same time, in combination with the sea air, acts as a tonic.

Sea-baths should not last more than five minutes. They are especially valuable in the case of weak digestion, or when the skin is affected. The bath should be taken before breakfast, or some hours after a meal. Bathing immediately after taking a meal is dangerous, for the blood is required to digest the food in the stomach and the effect of bathing is to drive it to the surface of the body by the power of reaction as already explained, and such interference with the functions of digestion may have very serious results. After the bath, exercise should be taken to keep up the circulation.

Artificial Baths.—Cold baths, from 50° to 75° Fahr. are stimulating, if taken as a plunge, and if the constitution is strong enough to bear them.

Warm baths from 90° to 98° Fahr. are sedative, but weakening if taken too frequently.

Hot baths from 98° to 112° Fahr. may be either exciting or debilitating. Hot baths are often thought to be weakening or relaxing, but to certain constitutions they are more invigorating than a cold bath and less likely to produce congestion. In Japan extremely hot baths, 110° to 120° are in common use among all classes of the people, with very beneficial results.

The tepid bath 82° to 90° Fahr. is the true hygienic bath. It cleanses the skin, refreshes the body when tired and tranquillises the nervous system. It also makes the muscles supple, urging to the surface those deposits which have a tendency to settle amongst their fibres.

Infants should be bathed daily in tepid water, to keep the skin in good condition, otherwise it will soon lose its activity. The tepid bath also soothes them and induces quiet sleep. With healthy children from two years of age the cold or cool bath should gradually be substituted for the tepid bath, as it is more invigorating, and should be continued daily as long as the constitution can stand it.

Cosmetics.—The use of ointments in a regular way is not to be recommended, as they are apt to interfere with the function of the skin. In case of roughness or dryness of the skin however their application is sometimes necessary. They should be carefully selected, and should be composed of well-known substances, such as vaseline (petroleum jelly), lanoline (oil of sheep's wool), &c.; those highly scented or coloured should be avoided, as they frequently contain injurious matter.

Paint.—Paint, powder, or colouring cosmetics, should never be used, most compositions of this kind contain lead, silver, mercury, or other deleterious substances, and even when harmless in themselves, their use hinders the natural action of the skin and increases the very defects they are supposed to hide.

VII.—EXERCISE.

Exercise is as much a necessity of life as nutrition.

Many of the actions of our organic life are carried on quite involuntarily on our part, we breathe, assimilate our food, &c., without making any conscious effort of the will. Some actions however, such as movement of the body itself, or of various parts of the body, are under the control of the will, can be regulated by us and are therefore known as voluntary movements. It is the employment of such voluntary movement we mean, when we speak of exercise.

PHYSICAL CONDITIONS OF EXERCISE.

Three agents are necessary to Exercise, the nerve which carries the message from the brain, the muscular fibre which executes it, and the blood-vessels which supply the necessary nourishment to the muscles and nerves.

The nature of the power which runs through the nerves and excites the contraction of the muscle is not clearly understood. It has been compared to the electric fluid.

Of muscular contraction more is known. Muscles consist of bundles of muscular fibres, all running in the same direction. If a stimulus be applied to a muscle it responds by a certain movement, it vibrates or contracts. All muscles have the power of contracting, and when they contract, become shorter and thicker. The ends of the muscles are firmly attached, by tendons, to the bones of the body in such a manner that in contracting they draw up the bones. Take, for example, the biceps, the powerful muscle of the arm; one end is attached to the shoulder-blade the other to the forearm. When we wish to bend our arm a message is sent from the brain by the nerves to the bicep muscles; the muscle contracts, and in contracting pulls up the forearm, and thus the arm is bent. When we wish to leave off bending our arm the message is no longer sent by the brain, the muscle ceases to contract, the forearm falls by its own weight, and the arm becomes straight again. The two ends of a muscle are never attached to the same bone, but between the two attachments, there is always an articulation, or joint, which allows movement between one bone and another. It is by contraction and relaxation of the muscles, excited by the nerves, that all the voluntary movements of the body are performed.

Each muscle in the body is shaped in accordance with the work which it has to perform; there is always harmony between the organ and the function which it has to discharge. The work of a muscle is always proportioned to its size and weight, and we can judge from its size of what force it is possessed and of what work it is capable.

The bones themselves, though seemingly hard enough to be incapable of change, become modified in shape under the slightest pressure if long enough continued. Thus muscular movements exert a great influence over the bones and scientifically arranged muscular exercises, as in the case of medical gymnastics may be successfully employed to cure deformities arising from misshapen bones.

The muscles and nerves must be nourished by means of blood-vessels; if not supplied with blood they would become powerless and useless. Exercise causes a certain waste of muscle, but this waste is continually made up by the blood, which is always receiving fresh supplies of oxygen in the lungs, and nourishes the muscle both with oxygen and with the various constituents it has received from the food. The blood which flows from the muscle after contraction is dark in colour, showing that the oxygen in it has been used up during muscular exercise. By oxidation heat is produced, and it is this heat which gives the muscles the power or energy to contract, and at the same time makes our bodies warm. The steam engine furnishes us with a well-known example of the power or energy derived from heat. Just as the steam engine derives its power of motion from the oxidation of its fuel, so we derive our power of muscular movement from the oxidation of our food. It follows therefore that fresh air and nourishing food are necessary if our bodies are to be kept healthy during exercise.

Muscles form by far the greater part of the total bulk of the human body.

During muscular contraction the heart beats more rapidly and the circulation is accelerated, the quantity of oxygen absorbed and of carbonic acid exhaled is more than doubled, the temperature of the body is raised. The secretions of the skin are increased, appetite is quickened and the digestive functions rendered more energetic, for the waste of the tissues being greater, the process of renewal by alimentation must take place more rapidly.

All the muscles of the body should be exercised, for muscles become feeble if allowed to remain idle. The greater power of the right side of the body over the left, and the increased development of muscles brought continually into play in certain occupations as for example in the arms of the blacksmith, show the effects of muscular exercise.

HYGIENIC EFFECTS OF EXERCISE.

Exercise is necessary to keep the body in health, but it must be suited to the powers of the organism.

The effect of *moderate exercise* is most beneficial, aiding the digestive functions, developing the muscular system and increasing the vigour and energy of the whole body. It should not be of too long duration, as intervals of repose are indispensable.

Excessive Exercise causes fatigue, weariness, lassitude, for the repair of the tissues of the body cannot keep pace with their waste. A constitution thus enfeebled falls an easy prey to disease.

Insufficient Exercise on the other hand, especially if accompanied by a plentiful diet, is most injurious. The circulation is not sufficiently active, too little oxygen is absorbed and the digestive system does not work well. The secretions are diminished, and an abnormal fattening results. The muscles, penetrated with fatty matter, lose their elasticity, the senses are rendered less active and the intellectual faculties become torpid.

Prematurely imposed work.—Exercise, as we have seen, should be suited to the organism and grave evils result from work, of which they are physically incapable, being imposed on young children. Such prematurely imposed work has a most disastrous influence on the public health, for it not only injures the individual who is submitted to it, by arresting his physical and intellectual development, but it makes its effect felt on future generations, born of these enfeebled constitutions.

It is one of the duties therefore of Hygienic Science, to so instruct popular opinion and awaken public spirit that steps may be taken to prevent the employment of children in such occupations as impair their powers and oblige them to live in atmospheres hurtful to their normal development and general health.

Dangers of over-exertion.—When the resistance to be overcome requires a considerable amount of muscular exertion it causes what is called Effort; thus we have to put forth effort to jump, run, cough, sneeze, lift a heavy weight, &c. Effort begins with a deep inspiration while the walls of the chest become fixed and immovable, in order to furnish support to the muscles which are about to act. Effort therefore necessitates a a momentary suspension of the breathing and obstructs the entrance of the venous blood into the chest while it compresses the vascular and nervous vessels.

Violent exertion may result in the production of tumours, hemorrhages, or even in the rupture of the heart, or of the large blood-vessels.

It is to the sudden putting forth of effort that the greater number of fractures, resulting from falls, may be attributed. Children who are heedless, drunkards who are unconscious, seldom fracture themselves, because they make no effort to save themselves.

PRINCIPAL FORMS OF EXERCISE.

Standing can hardly be called exercise, but attention must here be drawn to the injurious effects of continued standing. It is a frequent cause of tumours of the legs and of varicose veins in those whose occupations subject them to it. A natural result of maintaining the position for any length of time is that the body becomes tired, the stander leans to the right side which is stronger than the left. The spinal column is thus thrown out of the perpendicular, and should this attitude be often assumed spinal curvature will be the result.

Walking in proportion to one's strength is an excellent exercise and productive of nothing but good. It quickens circulation and respiration, and in consequence all the actions of organic life. It is not sufficient however to develop all the parts of the body. Quick walking or climbing should not be indulged in by those suffering from affections of the heart.

Running, like all other violent exercises, should be indulged in with caution.

By *Jumping* fatigue and breathlessness are caused. The effects vary with the height to which the body is raised, the intensity of the effort and the greater or less agility of the jumper. It will depend to a great extent upon the powers and constitution of the athlete and upon the duration of the exercise whether its effects will be beneficial or otherwise.

Games.—Games include fencing, cricket, tennis, cycling, swimming, boating, and dancing.

Fencing in the open air, although not such a favourite English sport as cricket, may be hygienically considered the more useful game, as it exercises all the subsidiary muscles and adds to the grace and suppleness of the figure. It developes the muscles of the neck, arms, feet, eyes, &c.

Cricket, splendid in all other respects, necessitates some amount of over-exertion.

Tennis is to be preferred to boating, as the position while playing is one of perfect ease and grace, while that assumed in rowing somewhat cramps the figure and developes more especially the upper part of the body. Tennis is suitable both for boys and girls.

Cycling.—If the machine used is in proportion to the rider and properly adapted, cycling is a fine healthy exercise for both sexes. It trains the eye and hand in exactness, and while the weight of the body is borne by the machine it affords free play to the lower limbs. Care must however be taken to maintain an upright position otherwise contraction of the chest may result. The fresh air, the change of scene and life that may be enjoyed in a moderate bicycle ride are unattainable in any other exercise. Golf, swimming, and dancing are all good exercises.

Gymnastics.—Gymnastics are exercises applied in a regular system, so as to forward the growth and development of all parts of the body, to restore to it health and vigour when they have been impaired.

Putting on one side the difficult and dangerous athletic and acrobatic exercises as being outside the present consideration, hygienic gymnastics aim at developing the powers of the body in a normal and progressive manner, and re-establishing as it may be needed balance and harmony, and they should never be thought of as a means of producing prodigies of agility and hardihood.

It is naturally during the period of youth, while the joints are still supple and flexible, that gymnastics are chiefly valuable. By well directed gymnastic movements the diameter of the cavity of the chest may be enlarged. The importance of this is evident when we consider that in the chest are situated the heart and the lungs, and that on the capacity of the latter depends the amount of air received into the body, and consequently the amount of oxygen supplied to the blood.

In the hands of a skilful instructor, gymnastic exercises may remedy serious physical defects, thus the narrow chest of a delicate child may be made to attain healthy proportions, or the backbone of a child suffering from curvature of the spine may be effectually straightened.

Remedial classes for the physical training of girls have been established in various parts of London, by Miss Chreiman and others, who have made a careful study of this subject. The exercises adopted in these classes include the physical training of the eye, ear, &c., as well as of the limbs.

The Swedish Slöjd handicraft which has been introduced into England of late years affords an excellent series of gymnastic exercises. The various movements involved in sawing, planing, chiselling, &c., exercise in a thorough manner the muscles of the upper part of the body, while the process of modelling with the knife, which forms such an important feature of slöjd work, trains very efficiently the eye and hand, although it would not be sufficient where medical treatment is required.

Slöjd has this advantage over other forms of gymnastics that the mental faculties are exercised at the same time as the physical and that the interest of the pupil is always thoroughly enlisted in his work.

Gymnastic exercises of all kinds should be carefully graduated and should be in proportion to the strength, they should not be continued too long, nor pushed to the point of fatigue.

After the exercise, if the body is in a perspiration, care must be taken to avoid chills and recourse should be had to friction or rubbing. Flannel underclothing cannot be too strongly recommended to those who engage in gymnastic exercises. The reason for its use will be fully explained in Chapter VIII. on Clothing.

Rest and Sleep.

Rest and sleep, as well as food, are necessary to repair the system when it has undergone waste by exercise. Rest may be obtained by change of occupation, as in this way different parts of the body are brought into play. Intellectual work may furnish a rest for the body while bodily activity is often a very salutary relaxation for the mind.

Sleep is the great means of restoring the body when fatigued. The quantity of sleep required to keep the body in health cannot be definitely stated, as it depends greatly on the individual constitution. As a rule, less than seven hours is insufficient while more than eight hours is generally unnecessary, except for children, who require considerably more sleep than adults.

VIII.—CLOTHING.

General Considerations.

The careful consideration of the proper and healthy method of clothing ourselves is a necessary part of education. "Clothes," says one writer, "are our friends or our foes all the days of our life." The chief object of clothing from a hygienic point of view is to preserve to the body its normal temperature, which is about 98° Fahr. when in a healthy condition and unaffected by external agencies. The proper point of warmth is reached when the body is just short of moist. We are however always in danger of having the heat of our bodies lessened or increased by the influence of the atmosphere around. (See Chap. I.) Heat has a tendency to radiate or diffuse itself. If we exposed our bodies unguarded by clothing to a cold atmosphere the heat would radiate, and we should become chilled; or if, on the other hand, we exposed ourselves to hot sunshine, our blood would become overheated. Clothing is therefore employed for two purposes—to retain the heat of the body; and to guard the body from external heat.

Before passing to the examination of the best materials for clothing, we must consider the action of the skin. The skin covers the whole body. Its chief function is to aid in the purification of the blood by the exudation from its innumerable pores of a fluid called perspiration. This fluid consists of waste products of the body which have to be got rid of, and which if retained would prove injurious to the system. The importance of this function of the skin may be seen from the fact that animals which have been painted over with impermeable varnish have soon died.

The skin also acts as the great regulator of the temperature of the body. When the heat of the body is raised by exercise, or by external agencies, perspiration is given off more plentifully and by the loss of heat involved in the evaporation of the increased perspiration, the body is cooled (See Chapter I.). Serious results would follow were the heat of the body abnormally raised and the great safety valve of perspiration not allowed free play.

It will be seen at once that the free and unchecked action of the skin is absolutely necessary to health, and that any covering which would interfere with this must be discarded as unhygienic clothing.

We must be guided therefore in our choice of materials by two considerations, we must employ those which will best guard the body from atmospheric influences, and we must avoid those which would interfere with the action of the skin.

Texture.—Clothing may be made from animal substances, such as wool, silk, fur, or from vegetable substances such as cotton, linen, &c.

Of all materials wool best fulfils the conditions of healthy clothing. Its more or less hairy surfaces retain about the body a layer of air which is an excellent non-conductor of heat, and therefore helps to preserve to the body its normal temperature; it absorbs moisture, and being porous, allows the impurities from the skin to escape through it in the form of vapour. A loosely woven form of woollen material is the best and should always be used for the most important garment, the garment next the skin. In a climate subject to sudden changes like our own, the importance of such a covering for the skin is hardly to be over-estimated.

If a material of a less permeable character such as calico or linen be employed, the perspiration unable to escape through it will accumulate on the surface of the body, the temperature will be two quickly lowered, and a chill will be the result. Besides this, the waste products of the perspiration will be re-absorbed and will prove injurious to the system. The damp clammy feeling produced by a linen or cotton garment when worn next the skin is due to this retention of moisture. There is no more fruitful source of painful and dangerous diseases than chills, and these might in most cases be avoided by attention to the rules of healthy clothing. Great improvements have been made lately in weaving cotton material of a thick cellular texture so as to retain air and allow ventilation and thus gain some of the advantages of woollen clothing.

During violent exertion the conditions requiring hygienic clothing become exaggerated, and common sense has dictated that flannel shall be worn when such exercises as lawn tennis, cricket, &c. are engaged in. Young people should remember that when the body has been perspiring freely, it is particularly liable to chill; they should put on the extra coat in the pauses of the game, and as soon as it is over, should whenever possible, change the flannel garments which will then be found saturated with moisture.

Next to wool, as a suitable material for underclothing, comes merino, cellular cotton, then silk, after that calico, and lastly linen.

Washing of Woollen Garments requires special care, that they may not be made thick and impermeable and so become unsanitary. We must not imagine that because they do not look soiled so quickly as cotton or linen they may be worn any length of time with impunity. The fact that they are continually absorbing the impurities of the skin, points to the need of frequent washing.

Colour.—Light colours will naturally be chosen for underclothing as a matter of cleanliness. It is in connection with the heat of the sun, and therefore as regards outer garments, that colour is chiefly important. Dark colours absorb the sun's rays more readily than light ones, and are therefore warmer.

Form.—The form of dress will naturally be affected by climatic surroundings, but in all cases the dress should not impede the free movement of the limbs or exert pressure on the digestive, breathing, or circulatory organs.

The clothing of different parts of the body.

The Head must be protected from sun and cold. The covering should be light and allow of ventilation. Straw is the best material. The silk hats used by men, and the heavy military hats are most unhygienic, and often cause premature baldness. Women should be consistent as regards their head-covering. It should always be sufficient for the purpose of protection from heat and cold.

The Body and Limbs should be clothed in a garment of wool. The combination is the best shape, as it ensures a uniform covering over the whole surface of the body. Long sleeves are essential, as the arm is particularly sensitive to cold and doctors maintain that neglect of a warm covering for the upper part of the arm is a frequent source of illness.

Corset.—If used, the corset must be light and supple, and must on no account compress the body. Tight lacing is a practice it is impossible to condemn too strongly. Chinese missionaries, when censuring the cruel custom of contorting the feet, are often met by the rejoinder, that the English practice of tight lacing is much more barbarous. This is absolutely true, for while the former only affects an extremity, the latter injures all the most vital organs of the body.

Examining the body physiologically we find that the trunk is divided horizontally by a partition called the diaphragm. Above the diaphragm lie the heart and lungs, below it, the liver, stomach, intestines, &c. When the body is compressed by tight stays, the ribs which form the bony frame-work of the chest are forced in upon the internal organs in such a manner as not only to displace but often to seriously injure them; the lungs which act as the great blood purifiers, supplying oxygen to the blood, have not sufficient room to develope, respiration is restricted and sickness is often the result; the action of the heart is interfered with, circulation is hindered and palpitation and fainting follow; the liver and stomach are pushed together and digestion is rendered difficult; the normal play of the intestines is impeded, constipation is produced and the danger of rupture is greatly increased. Difficulties of menstruation also result from constraint in the abdominal circulation. It is not to be wondered at that when under such abnormal conditions, exercises such as dancing are indulged in, fainting is a common occurrence, and even cases of sudden death, have been the result. All true sense of beauty of form is outraged by tight lacing, as the figure is thrown entirely out of proportion. Red noses, pimples, blotches, appear as the outward and visible result of the practice, and point to the more serious inward consequences which are taking place unobserved.

This question assumes a still graver aspect when we remember that it is not only the individual health and life which are sacrificed. The majority of girls will probably become mothers. From weak and sickly mothers spring weak and sickly children; a physical defect in the mother often gives rise to a mental defect in the child, and idiocy in a succeeding generation has sometimes resulted from this foolish practice. We feel sure that ignorance is at the root of this evil, and that if young girls were taught to understand and to honour the structure of their bodies they would at once abandon tight lacing as a wicked and barbarous fashion.

Suspenders are much to be preferred to garters, as the garters hinder the free circulation of the blood, cause pain and weariness in the legs, and tend to produce swollen or varicose veins.

Petticoats should be so arranged as to let the weight hang from the shoulders, and not from the waist. Weight round the waist is to be avoided, as it imposes too much work upon the specially delicate organs of women. The divided skirt offers advantages, allowing greater freedom of movement while it protects the vital parts of the body more effectually from cold.

Stockings should be of wool or silk. Enough importance is not attached to keeping the feet warm. It should be remembered that cold feet are a frequent cause of congestion.

Boots should be solid, firm and supple, not too short; with square, not pointed toes, the heel large and low.

The human foot is specially constructed to enable man to maintain the upright position, peculiar to him. It is large and broad in proportion to his size. It is placed at right angles to the leg and is composed of many bones, so arranged as to form an arch; an arch being the strongest form it is possible to obtain. The oscalcis or heel-bone and the bones of the toes form the two points of support of the arch, while the weight of the whole body rests on its summit. The oscalcis is specially large in man and it is only in the human foot that it comes into contact with the ground. Apes have the oscalcis small and raised from the ground, hence their difficulty in maintaining the upright position for any length of time.

It seems strange that human beings should wish to deprive themselves of the advantages nature has bestowed on them, by the structure of their feet, but this they undoubtedly do when they follow the practice of wearing high-heeled boots. The oscalcis is then raised from the ground and the body loses its proper support. Walking under these circumstances becomes difficult, the gait is rendered unsteady, and backache and many other evils result from this foolish interference with the wise provisions of nature.

During sleep the body, or when tired or inactive, is more sensitive to cold. Care must therefore be taken to provide sufficient clothing during sleep.

Bed.—The feather-bed is not to be recommended, it induces perspiration and is enervating. A hair or wool mattress on the top of a spring-bed is healthy and comfortable. Curtains, if used, must be light, and while just sufficient to check draught must not impede the free circulation of air.

The amount of bed-clothing will vary according to the season of the year, it should always be light. Heavy quilts are to be avoided. Young people should not accustom themselves to too much bed-clothing as it enfeebles the constitution. Old people require their bed soft and warm.

The night-dress should never be put on over a day garment, for during sleep the skin will re-absorb the impurities contracted by the under clothing during the day. All clothing should be changed at night, in order that the day clothes may be aired and fresh in the morning.

Airing of clothes.—Many colds, congestions and interruptions of the important functions of the body are caused by wearing insufficiently aired under-clothing. Young girls should especially remember that articles of under-clothing which are to cover delicate or sensitive parts of the body require special care in drying.

Damp sheets a frequent cause of rheumatic fever, should be carefully avoided, should be removed from the bed altogether and the blankets slept in rather than any risk incurred to health from the neglect of sufficient airing.

Test for Damp Sheets.—Put a mirror or tumbler in the bed for a short time, and on taking it out observe whether the surface of the glass is clear or misty; if misty the sheets are damp.

Age.

Special care should be taken that old people and young children are warmly clad. As their circulation is less rapid than that of adults they produce less heat, and their clothing must make up for the deficiency. Young children should be covered, trunk and limbs, with flannel. With growing children tightness in clothing is especially to be avoided, and the materials used should be light as weighty clothes are tiring and exhausting.

Seasons.

In Spring and Autumn the changes in temperature are most frequent and sudden; clothing must therefore not be too thin at those seasons. It is well to adopt the warmer clothing before the colder weather sets in, and the change to lighter garments should not be made till the warm season has fairly begun.

IX.—DWELLINGS.

General Conditions.

In considering the question of dwellings in relation to health, we touch upon some of the most important points affecting both individuals and communities.

The purpose of a house is to afford shelter and protection from the weather, and to promote the well-being and comfort of the inhabitants, and yet it must be remembered that many of the diseases from which we suffer are traceable to the very houses which were intended for our comfort.

The great enemies to which we are exposed by living in houses, and by which the less civilized races are little attacked are impure air and impure water. Air and water will be considered in detail in Chapters XI. and XII., but the impurities of air and water confront us in every step of the house rearing, and render it imperative that strict attention be given to the exclusion of any kind of foulness from our habitations. In Chapter X. we will consider the situation of the house, the soil of the site, and the surroundings, but we will discuss now the general conditions of dwellings and the chief causes of their unhealthiness.

First we must think of the foundation of the dwelling. After the whole soil of the site and its surroundings have been well drained, the foundation under the whole surface of the house should be covered with a thick layer of good concrete to prevent unhealthy vapours or emanations rising from the soil into the house. It is also necessary to lay a *damp proof course* in the walls above the level of the ground. This damp proof course consists of slates, laid in cement, asphalte, or other impervious material, and effectually prevents the damp from rising in the walls by capillarity of the brick work.

The necessity and conditions of light for the individual have already been considered in Chapter II., and the same general truths hold good when applied to the house. Light is a great preventive of disease as well as the preserver of health, and tends greatly to promote cleanliness. And in order to secure plenty of light in our dwellings we must have large windows not too heavily screened and curtained. The exposure of the house to the sunlight is of great importance. We should endeavour to secure that as long as the sun is above the horizion it should shine on some part of the house; and the selection of the rooms would probably be that kitchens, larders, store rooms, &c., should have a Northerly aspect, while drawing rooms would face South-West and morning rooms South-East.

Drainage or Sanitary Arrangements.

Water-closets should be placed if possible in an outstanding part of the house, only connected with it by a passage. This passage should be provided with cross ventilation, that is, by windows or openings on opposite sides of the passage securing a cross current of air, so that all smell or foul gas arising in the closet would be cut off from the house itself.

But if this cannot be managed still the water-closest should always be placed against an outside wall of the house, and as far removed from the bed-rooms and sitting rooms as possible. The greatest source of danger and unhealthiness arising from water-closets lies in the fact that the excreta quickly decomposes, and may contaminate the air breathed by the inmates of the house, also that foul air, called sewer-gas, from the main sewer may by pressure in the sewer pipes be driven back through the water-closets and so into the house. Sewer gas predisposes to diphtheria, malaise typhoid, and puerperal fevers, and may also carry the germs of other diseases; and it may rise into the house through any of the pipes connected with the sewer—through the housemaid's sinks, the water-closets, or the overflow pipe of the cistern—unless proper precautions are taken to prevent it.

First then the water-closet should be provided with plenty of water to carry off all refuse. A small flushing tank, called a Waste Preventer, should be provided for each water-closet, which may be fed from the general cistern. The room must have one window at least, and it is best ventilated by the window reaching to the top of the room. It is also good to have a separate inlet for fresh air. The floor under the seat should be covered with a lead tray sloping to a hole in one corner from which a pipe is carried and cut off short outside the house, so that any water splashed over the pan may at once be carried off and not allowed to soak into the floor. The pan should be glazed earthenware, and have a glazed earthenware or lead syphon trap connecting it immediately with the soil pipe outside the house. No soil pipe should be allowed to pass under the floor of the house for even the shortest distance, for in the event of even a small leakage sewer gas might rise through it into the house. The soil pipe should be ventilated either by carrying up from it a 4-in. pipe above the highest point of the house, and as far from any window or chimney as possible, or by the soil pipe itself being continued upwards. The closet pipe joins the soil pipe at the side, the soil pipe passes down the outside of the house and empties itself into an open gulley or disconnecting trap in a large air chamber, called the manhole. This manhole is provided with an air inlet so that a current of fresh air is continuously passing through the manhole and up the soil pipe to the top of the house; if the manhole is situated near the house or in a pathway it may be closed with an air-tight cover. The open gulley is connected with the main sewer pipe, and all drains travelling from the house should be emptied into this gulley in the air chamber before passing on to the main sewer. All waste pipes from baths, sinks, and lavatory basins, and all rain-water pipes should discharge over an open gulley at the ground level, the drain from the gulley running into the manhole. Overflow pipes from cisterns and safe trays should be carried through the house wall and cut off short, and not be connected with the drain at all. The purpose and benefit of this arrangement are evident. Should any sewer gas be driven back up the sewer pipe into the manhole it joins the current of fresh air which is passing up the soil pipe and is carried to the top of the house and discharged into the open air, where it will be so quickly diluted with fresh air that it will do no harm. If ventilation of this kind were not provided the air from the sewer would probably force its way through the water in the trap of a water-closet, bath, or lavatory, and enter the house.

For country use the *Earth Closet* as introduced by Moule and slightly improved by Taylor is the simplest and most effectual plan for the disposal of excreta without offence or injury to the inmates of a house.

The principle is to receive the excreta in a pan containing dry earth, a small quantity of which is again sprinkled after each time the closet is used. Dry earth is a great deodoriser, removing smell. Dryness being an essential to the effectiveness of this closet it is evident that no slops should ever be put into it.

But no amount of care in the construction and apparatus of a house will render it a healthy dwelling unless perfect cleanliness is maintained in every detail. Cleanliness is essential in every place; where food is kept, nothing in the least tainted should ever be allowed to remain; in the laundry, all soiled linen should be washed at frequent intervals, since nothing is more stuffy and offensive than heaped-up dirty clothes; in the use of filters which have been already spoken of. Cleanliness is also requisite in the use of drains. The use of drains must be restricted to the special purpose for which they are made and adapted, and must not as is too often the case be used as rubbish holes. For the removal of dust and rubbish, galvanized iron dust boxes are the best for town houses. They should be placed just outside the house, covered but not closed in, and nothing but dry dust and rubbish should be put into them. All scraps of an organic nature either animal or vegetable should be burnt if possible. The dust box should be emptied by the sanitary authorities not less often than twice a week.

Ventilation.—The properties of air, its composition, changes, and the impurities found in it, are fully referred to in Chapter XI. What we have to consider here is air in relation to houses, where the air is confined and breathed in limited spaces.

It is clearly set out by Prof. de Chaumont that every man of average size requires about twelve cubic feet of pure oxygen in twenty-four hours for mere existence and about half as much again if at work. As we shall see later on air only contains one-fifth of oxygen, so that if a man could consume and combine with other matters every particle of oxygen the air contained, he would require about sixty cubic feet of air daily for mere existence and about ninety including his daily work. But as it is impossible to consume and combine more than a very small portion of the oxygen of the air owing to the vitiation of the air as explained in Chapter X. the supply must be very much greater. It is found that 3,000 cubic feet of air every hour is the minimum quantity with which each individual must be supplied for the ordinary purposes of life exclusive of work. We will now consider how this should be applied to the calculations of the size of sleeping rooms, remembering that about half as much again is required on an average where any exercise is undertaken.

To obtain 3,000 cubic feet of air the air must be changed three times an hour in a room containing 1,000 cubic feet, this would be a room measuring ten feet in in every direction. This would be sufficient for one person. If the room contain only 500 cubic feet the air must be changed six times in every hour. How difficult to accomplish anything like this without draught! or keep up the temperature of the room during the process. Still in spite of the difficulty much may be done by adopting some of the ingenious contrivances now in use for ventilation. But before considering these, attention must be paid to the fact that allowing that 500 cubic feet per head is the smallest amount permitted in sleeping rooms, the cubic space of the room must be reckoned irrespective of all furniture, which necessarily diminishes both the floor space and cubic space for the inmates. It will not do either to reckon anything above twelve feet in height as effective in considering cubic space. The principle is shewn in the fact that a man may be suffocated in a pit or a deep well for the want of lateral space. Therefore all calculations should be made on floor space and total space combined.

When fully convinced of the need of pure air to breathe in our rooms, we naturally ask, How shall we know when the air has become impure? and, How shall we be able to renew the air sufficiently often to keep it pure? Prof. de Chaumont shewed that a smell of stuffiness in a room became perceptible if not offensive when the carbonic acid due to the impurities of respiration reached 2 parts in 10,000 of air in measure over and above the average amount in pure air which is already 2 parts in 10,000. We must therefore endeavour to keep off any smell of stuffiness from our rooms. And this stuffiness must be judged by immediate comparison with fresh external air, for no sense is so soon dulled as that of smell and the closeness grows without being perceptible to an inmate of a room, who would feel it terribly offensive in returning after an absence of only a few minutes duration in fresh air. This brings us now to the subject of the best means of ventilation.

The two most important points in ventilation are, that the air of a room shall be completely and continuously changed so that the standard of impurity shall never be reached; and that in accomplishing this no current or draught shall be perceptible by the inmates of the room. Added to these we must be careful to retain the temperature that is comfortable and healthy, and the air must never be allowed to become either too dry or too moist. The last two points may be conveniently considered under the heating of apartments. The first two may be attempted in one or other of the following ways, either by *openings at windows* or *openings at the floor line with upright tubes.*

Of the *openings at windows* the simplest plan is that suggested by Doctor Hinckes Bird. The lower sash of the window is raised a few inches and a narrow board placed at the opening so as exactly to fill up the space. This prevents any draught, for the incoming current between the two sashes is directed upwards and becomes diffused in mixing with the air. As there is generally at least one inch of opening in width between the sashes 36 square inches of fresh air are at once obtained on a window three feet wide, and Professor de Chaumont has shown that an opening of 24 square inches is sufficient to bring in fresh air for each person.

Of the *openings at the floor line with upright tubes*, the best contrivance is that known as a Tobin Tube. It consists of a tube about 5 feet high and 24 inches or more in sectional area fitted against the wall or the room; fresh air is introduced through an opening in the wall near the bottom of the tube; the current through it has an upward tendency which it keeps for some time before spreading. The opening on the outside of the wall is covered with a grating and the tube inside is provided with a cover that it may be closed in cold weather.

It is not sufficient for good ventilation only to supply inlets for fresh air, outlets must also be made for foul air to pass away, and these would be best placed near the top of the room, and should make with the chimney an opening equal to the inlet, which in large rooms intended for many occupants, should be considerable. When not in use the chimneys should never be boarded up as they provide one of the best and easiest methods of securing the ventilation of the room. A small chimney throat 8 inches by 6 gives 48 inches which is sufficient outlet for two people.

Heating.—In ventilating houses it is often wise to try to supply warm fresh air, as in cold weather it is difficult to admit a sufficient quantity without cooling the rooms too quickly.

One of the simplest arrangements is that in Sir Douglas Galton's grate. A little chamber is built behind the fireplace into which the outside air is brought through a ventilating brick and is warmed by the heat of the fire; it then passes out at an opening above the chimney piece and so supplies fresh air and warmth at the same time.

Where stoves are used the air of the room is apt to become too dry, and it is then necessary to have a vessel of water in the room which will gradually evaporate and moisten the air. But while providing that the air is sufficiently moist care must be taken that it does not become damp. It is often overlooked that much unhealthiness is caused by the damp arising from washing floors. If washed the floor must be dried quickly and the room must not be occupied until it is perfectly dry.

The most pleasant and most usual mode of warming rooms in this country is by means of the open fireplace and though very wasteful if not constructed so as to throw out the greatest amount of heat, they yet have one great advantage over stoves. The open fire warms the walls, floor, furniture, and occupants of a room by radiation and warms the air almost entirely by reflection, thus the air is comparatively cool to breathe while the occupants and furniture are warm, while stoves warm the air first, often overheating it, before any parts of the room are rendered comfortable to the touch. A good form of construction for a fire grate is one which projects well out into the room, and if the back of the firegrate be only one-third the width of the front and the depth be the width of the back it is found that all the heat will be reflected into the room instead of to the opposite side of the grate and so up the chimney.

Causes of Unhealthiness in Dwellings.

It will be well to close this chapter with a summary of the most frequent causes of unhealthiness in dwellings. First are faults in the house construction. The want of proper foundations and good damp proof courses. Insufficient lighting. Misplacement of water-closets. Soil pipes passing through the house. Want of ventilation of the soil pipe and drains and neglect of proper disconnection for waste pipes and house drains.

Then come the faults in the house-keeping. Want of cleanliness in larders, in laundries, in the use of filters. Want of cleanliness in the use of drains and of dust-bins. Added to these are the want of care in allowing sufficient space for sleeping rooms ; and the impurities of the air arising from want of good ventilation.

One great cause of unhealthiness in many of our London houses is a custom which pertains largely in certain classes of society, namely that of closing the house during the family's absence from town.

Nothing could be more pernicious than this from a sanitary point of view. It is true that it is good to leave rooms unoccupied for a time, and the importance of so doing has been recognised by a good many hospitals who now put the principle into practice. But the object of leaving them unoccupied is that they may be thoroughly and continuously flushed with air in order to get rid of any impurities that may have collected in them. This object is not attained by leaving a caretaker in a closed house, for then the probability is that a tour will be made of the house, and windows opened a crevice at the most but once a a week. Stagnant air and stagnant water will be everywhere accumulating, and will be absorbed by the woodwork and the furniture, to be given off when the house is re-occupied, vitiating the air to be breathed by the inmates.

If trustworthy servants could be left in charge of unoccupied houses who would keep them open and not closed, flushing the rooms with sweet fresh air in every nook and corner and flushing all tanks, sinks, and pipes with clean water daily, the occasion might be made one of increased health and invigoration instead of as now being a constant cause of increased unhealthiness in dwellings.

X.—SOIL.

Influence of the Soil on Health.

Soil, like air and water, exercises a great influence on health; for in a large measure it determines the condition of the atmosphere passing over it, and where the same soil extends for great distances it affects the climate of the country.

The most healthy soils, under certain conditions to be mentioned presently, are gravel, sand, chalk, and rocky soils, such as those composed of granite, limestone, etc. These allow the water to percolate through them and drain away, leaving the surface of the land dry and healthy. Clay soil, on the contrary, forms an impermeable stratum, retaining the rain and surface water and rendering the atmosphere chill and dank. A clay soil is often to be seen covered with a low white mist.

This cold damp soil is the cause of a great deal of sickness and unhealthiness to those residing upon it. It gives rise to gout, rheumatism, disease of the kidneys, and chilblains.

Now although the surface of the earth may be a good gravel or rocky soil, it may have immediately below it a subsoil of a clayey nature, rendering the atmosphere more damp and unhealthy than when the clay is on the top. For if the impermeable stratum on the top is inclined, the water runs off and all is well, but if it lies below the gravel it retains the moisture and produces the cold humidity of atmosphere referred to. This is the condition of marshes, and in the neighbourhood of marshes are always found intermittent fevers, tubercular, and scrofulous complaints.

All soils contain mineral, vegetable, and animal substances, besides air and water in their interstices, and vegetation acts upon the soil in different ways in different climates.

Vegetation makes cold climates colder. Trees obstruct the sunshine and hinder the evaporation of the cold damp moisture from the earth. It has often been found that removing trees renders the climate milder. In hot climates the trees shade the ground from the sun's rays and keep the earth cool, by themselves evaporating the moisture from the ground; they also cleanse the ground of decaying substances contained in it.

Choice of Soil for the Site of a Dwelling.

It is generally speaking only in the country that one has the *choice* of a site for their house, and the subject is not of such importance in towns where the surface and subsoil are or should be always well drained and the streets paved. The temperature also is always more equable in towns than in the open country.

Elevation.—The elevation of the site, both as regards its height above the sea level and its position with regard to the surrounding country, is a matter of some importance.

The height above the sea level will greatly affect the dryness of the soil and subsoil, will give a better exposure to light air and wind, and the air itself will always be purer and dryer at a good elevation.

The level of the site with regard to the surrounding country must be considered. Hollows, or dips in the hills are bad for they hold the cold damp air, also the banks of rivers unless the site be raised above the level of the stream and well beyond the reach of even occasional flooding. A slope of a hill gives a good site, if the building be placed upon a terrace or a spur of the hill so that the air may circulate freely about it.

A clay soil is not always unhealthy if properly drained, but usually in a cold country clay is found too cold, and in a hot country sand is too hot and dry.

The ground water is found at different depths below the surface of the earth at the point where the ground is completely saturated with the water percolating from the surface. It should for health's sake never be nearer the surface than 5 feet. This is the water that feeds the wells, and in some neighbourhoods it is not found nearer the surface than 15 feet. Should the site of the dwelling be damp, the subsoil must be drained to lower the level of the ground water and the surface also well drained. Care must be taken that there are no stable cesspools, foul streams, or ponds draining towards the house.

Vegetation about a house is good. Trees dry the ground and moisten the atmosphere. Grass cleanses the ground, raising up any organic matter in the soil. The Eucalyptus and the Sunflower answer the same purpose.

The house should be so situated that the sun may during the whole day shine upon some part of it. Doors and windows should open as much as possible to the sunny quarters. The south is the best for the young and the feeble; the air is purer as well as warmer than in sunless rooms. The east gives all the good of sunrise but it needs protection from the east winds, and for this purpose a belt of trees is better than a more impassable barrier such as rising ground, for through the trees the air can play upon the house while the wind is prevented striking directly upon its openings. From the west and north-west come most of our cold wet winds. The south-west winds are more uniform, but are humid. On the whole a south-easterly aspect is the best for our climate.

XI.—AIR.

PROPERTIES OF AIR.

Meteorological Phenomena.

Fogs, Clouds, Rain, Snow, Hail, Winds.—In a previous chapter on Heat we have spoken of solar light and its influence on all living organisms, and we have seen the great importance of radiant heat, but we have not yet noticed the part which air plays in the distribution of light and heat.

It is to the atmosphere surrounding the globe that we owe both the diffusion and the conservation of light and heat. The atmosphere itself is diathermous, that is to say perfectly dry air can be penetrated by the rays of the sun or by radiant heat, without being itself warmed by that heat. It is also transparent and permeable to the light, and it does not itself reflect any part of the light. But when vapour is added to this air and its relative humidity increased its diathermacy is diminished; so that both the solar radiation and terrestrial radiation are much less felt on the surface of the earth when the air is humid—the vapour screen forming one of the most important functions of the atmosphere in the conservation of heat.

It is this vapour of water mixed with warm air under the equator that carries the heat to other latitudes less directly under the rays of the sun. The movements of air which result from the unequal temperature of its different layers constitute the winds.

Those rays of the sun which reach the earth's surface and fall on the land and solid bodies are generally wholly absorbed by the thin surface layer exposed to the heating rays. The temperature of the surface consequently rises and while the temperature of the surface increases a wave of heat is propagated through the soil, but this only affects the earth perceptibly to about a depth of four feet.

The influence of the sun's heat on water is very different. Only part of the heat is arrested at the surface, the rest penetrating to a distance of sometimes nearly 500 feet below the surface of the sea. This is an important distinction between land and water surfaces in their bearings on climate. Keeping in mind that about three-fourths of the earth's surface is water and that the temperature of the air is in close relation to the temperature of the surface it rests on we see that by the intervention of the winds the temperature of the water has an important effect on the air covering large portions of the land surfaces of the globe.

It will be shown later on that the dry atmosphere of the earth consists of oxygen and nitrogen, is always a gas and its quantity remains constant. But there is also an atmosphere of aqueous vapour which is not always in a gaseous state, and the quantity in the air is constantly changing by the process of evaporation and condensation.

Evaporation.—As the temperature rises the air can take up a greater quantity of vapour, but at every degree of temperature it can hold a certain amount of vapour and no more. When air can contain no more moisture it is said to be at the point of saturation, and as soon as more vapour than this is present it begins to condense into cloud or rain, snow mist or dew according to the surrounding circumstances. Aqueous vapour is constantly being added to the air from the surfaces of water, snow and ice, and from moist surfaces and from plants. The rate of evaporation increases as the temperature of the air rises, because the power of the air to hold moisture is increased with heat. This is why water dries up much quicker in warm air than in cold. Evaporation ceases when dry air has taken up all the moisture that it can hold, which is a definite quantity according to its temperature. Air is said to be moist or dry according to the proportion of vapour it contains; if at a temperature at which it *can* contain 100 parts of vapour it only *does* contain 75 parts it is said to be only three-quarters moist or to have 75 per cent. of humidity.

Condensation.—As during clear and calm nights the earth gives off its heat by radiation the temperature of objects on the surface is gradually lowered, and at a certain point the aqueous vapour in the atmosphere is condensed into dew. The temperature at which this occurs is called the Dew point.

Dew is not formed during cloudy nights because the clouds prevent the heat escaping so quickly by radiation, nor during windy weather because the wind is constantly removing the air in contact with the earth and prevents the temperature from falling sufficiently low. When the temperature is below 32° Fahr., the dew freezes as it is deposited and forms *hoar-frost.*

Mists and fogs are visible vapour floating in the air near the surface of the earth, they are produced by the temperature of the air being reduced below dew point; this may be caused in any way, such as by the mixing of cool air with air that is warm and moist, or by the cooling of the air in contact with the surface of the earth, where its temperature has been lowered by the night's radiation. London fogs owe their density to the smoke and particles of carbonaceous matter mingling with the condensed vapour, and their persistency is due to a coating of coal tar and grease surrounding the globule of moisture and retarding its evaporation.

Clouds are formed in the same way as mists and fogs but in the upper regions of the atmosphere. Their forms are very various, and we can only refer here to few of the most clearly defined. The *cirrus* the *cumulus* the *cirro-cumulus* and the *nimbus* or rain cloud. The *cirrus* cloud is the highest of all, it has the least density and takes the greatest variety of forms. It consists of wavy, parallel or divergent filaments which may increase in any or all directions; it is thought that the particles composing it are minute crystals of ice or snow-flakes.

The *Cumulus* is the name given to those heaped up clouds which are found in a lower region of the atmosphere than the *cirrus.* They form the tops of the ascending currents which rise from the heated ground, they are often called "the cloud of day" from the time at which they are most frequently seen.

The *Cirro-Cumulus* is made up of small roundish masses, lying near each other and quite separated by intervals of sky. It looks as if it were made from the cirrus, as if the fibres of that cloud broke up and collapsed into roundish masses breaking the texture but retaining the arrangement of that cloud. This beautiful cloud is often described as the mackerel sky, and is most often seen during dry warm summer weather.

The *Nimbus* or rain cloud is the system of clouds from which rain is falling. When the vapour remains in a state of cloud the droplets are so small that they hang suspended and can be borne onwards by the air, but when they increase in size by the droplets joining together they become too heavy for suspension and fall to the earth as rain.

Snow.—When the temperature is below freezing point the excess of vapour instead of condensing into rain is precipitated in frozen particles, which uniting in little masses form snow. The building up of the snow is a construction of great beauty. Each little particle follows the laws of crystallization in uniting with its fellows, the result is snow crystals of the most beautiful and varied forms. Several hundred different kinds have been observed. In the same snowfall the forms of the crystals are generally similar. The smallest flakes occur with the lowest temperature, and the largest when the temperature is nearly 32° Fahr., the average size is about $\frac{1}{8}$ inch in diameter. The white colour of the snow is caused by the combination and interference of the light reflected from the surfaces of the many crystals lying in all sorts of positions.

Hail.—In higher latitudes hail only falls during the warm season. It escapes exclusively from storm clouds, and it is noticed to accompany day storms more than night storms.

Wind.—All wind is caused directly by atmospheric pressure, just as the flow of rivers is caused by the difference of the level over which they run. The motion of air and the motion of water are both controlled by the laws of gravitation or of weight. The wind blows from where there is a surplus weight of air to where there is a deficiency, and this difference in atmospheric pressure; and consequently all winds are caused by changes occurring either in the temperature or in the humidity of the air over limited regions. If two neighbouring regions of air are of unequal temperature the air of the warm region being lighter will ascend and the air of the cooler region will flow in below to take its place. The sea and land breezes are a good example of this.

The causes which bring about wind are chiefly two—the heat and the moisture of the atmosphere, with regard to land and water. As has been shown p. 22 the summer temperature of the land greatly exceeds that of the ocean in the same latitudes. Hence the excessive heat in the interior of the continents of Asia, America, and Australia during their summer. In consequence of this heat the air becomes specifically lighter, and it therefore ascends in enormous columns thousands of miles in diameter. On reaching the higher regions of the atmosphere it flows over those regions where the surface temperature is lower. It is in this way that the atmospheric pressure of the very hot regions is diminished.

Surface winds blow in all round to take the place of the heated air that has risen, and as these are necessarily winds from the ocean they are highly charged with aqueous vapour, and by the condensation of this vapour into cloud and rain the pressure is still more diminished.

The effect of the winds upon the organism may be either exciting or depressing. Moderate cool winds exercise a bracing effect upon the skin; they increase the circulation of the blood and thus aid the function of the body; but they have too great a cooling effect if the body is covered with perspiration and must then be carefully avoided, being the cause in our own climate of frequent chills which bring on rheumatism and catarrhal affection of the nose and bronchial tubes. The warm humid winds are depressing; in such an atmosphere the functions of the skin and lungs are hindered or suppressed and too great an activity is forced upon the loins and mucous membrane. If the wind is cold and humid then less oxygen is absorbed by the system and there is a slackening of combustion, this entirely disorganises the lymphatic system or tissue growth, the nerves enlarge, the flesh fattens enormously and there is great feebleness of the nervous system, the organism becomes too enfeebled to manufacture the blood globules which are wanted to absorb oxygen. Cases of this kind are met with in the fen countries, and often nothing but a change of atmosphere is required to restore perfect health.

ATMOSPHERIC PRESSURE.

It was long supposed that the height of the atmosphere did not exceed 45 miles. This was gathered from observations made on the refraction of light, but during the last few years from observations made on luminous meteors it has been inferred that the height of the atmosphere is at least 120 miles and possibly in a very attenuated form it may reach 200 miles.

The pressure of the atmosphere constantly diminishes with its height. That closest to the earth is pressed by all the air above it, while that at the top of a mountain is only pressed upon by the air above, that lying between the top of the mountain and the level of the sea exerts no pressure whatever upon it. The pressure of the atmosphere at the level of the sea is about 15 lbs. to a square inch. The surface which a man of average figure presents is estimated about one and a half square yards, thus he supports an atmospheric pressure of from 15 to 20 tons. This pressure far from being troublesome is indispensable, it gives cohesion to the tissues, maintains organic liquids in the vessels which enclose them, and exerting itself in all directions both internally and externally it balances itself.

The barometer is an instrument used to indicate the weight of the atmospheric column. The pressure of the atmosphere must necessarily vary with the altitude, that is to say with the greater or less elevation above the level of the sea at which the observation is taken. In proportion to the elevation the column of air diminishes in height and also in density, the pressure is consequently lighter and the barometer falls almost an inch each thousand feet of elevation.

The effects of atmospheric pressure on our organism are chiefly felt when the pressure diminishes, when we pass from a heavy pressure to a lighter one.

A sojourn in mountainous districts where the pressure is little, exercises a favourable influence on those who are debilitated by a long residence in the midst of large cities.

The more sudden the diminution of atmospheric pressure, the more are its effects felt.

In making the ascent of high mountains, however, another consideration intervenes, there is a considerable expenditure of force necessitating a large supply of oxygen, and the quantity of oxygen in the rarefied air of great altitudes is insufficient. The traveller feels giddiness, palpitation, and sensation of fulness in the vessels, the respiration becomes constrained and laborious and the pulse is accelerated.

In balloon ascents though the human machinery makes no outlay of power for its elevation, the transition to rarefied air is more sudden and the evils are sometimes greater; in this case there is acceleration of respiration, and sometimes hemorrhage and fatal attacks of syncope.

In passing from a less to a greater pressure of air, as in the work of mines and in diving for the purpose of constructing bridge foundations, the body undergoes certain changes, but the accidents that frequently happen generally occur at the moment of repassing into the more rarefied air.

RESPIRATION.

The importance and necessity of a suitable atmosphere for respiration constitute a question of Hygiene of the greatest importance. We are more at the mercy of the air we breathe than of any other influence, for we can abstain for a long time from food or water if we suspect or doubt their wholesomeness, but in the case of air we have no choice, we must breathe even though the air be poisonous or we shall surely die. It is difficult to explain the utter unconcern which is often shown with regard to performing respiration under good conditions.

Respiration.—The great object of respiration is to purify the blood. It is in the lungs that this purification takes place, and in order to understand how it is effected we must examine the structure of the lungs. The lungs are two spongy pink bodies, contained, along with the heart, in the cavity of the thorax, or chest. The windpipe, descending from the throat, divides into two branches, one to each lung. These branches, called bronchial tubes, divide and sub-divide, like the branches of a tree, till they end in small bladders called air-cells. These air-cells are very small and numerous, the total number in the lungs is estimated at 600,000,000. Their walls are composed of the thinnest possible membrane. Around them is wrapped a network of extremely minute blood-vessels, called capillaries, into which the blood, which has become foul in its passage through the body, passes, in order to be purified. By every breath we breathe oxygen is introduced into the lungs and passes down into the air-cells. Here, by a process called osmosis, it finds its way into the blood. Osmosis is the property which membranes, such as bladders, possess of letting certain substances pass through them. If we put a bladder filled with a solution of sugar or salt, and with its neck tied tightly, into a basin of water, the sugar or salt will pass through the bladder until the water in the basin is as strong of sugar or salt as the water in the bladder.

By osmosis oxygen from the air we breathe passes through the delicate bladder-like membrane of the air-cells of the lungs into the blood, while carbonic acid gas passes from the blood into the air of the air-cells to be expelled by expiration. The blood thus purified in the lungs is of a bright red colour, leaving the lungs, it travels through the blood-vessels of the body, giving up as it journeys on the oxygen it has received to the tissues, and receiving from the tissues carbonic acid gas. By the time it has completed the circuit and reaches the lungs again it has become of a dark purple colour, owing to its loss of oxygen and gain of carbonic acid gas. Entering the capillaries of the lungs the process of purification is again repeated and thus the oxygen necessary to life is supplied.

The lungs are assisted in the work of purification by the skin; waste substances of the blood, notably carbonic acid gas, being given off by means of the watery fluid it exudes through its pores.

Consideration of the function of respiration shows us clearly that in order that the blood may be properly purified it is absolutely necessary that the air we breathe should be pure air, containing a proper proportion of oxygen and not holding an undue amount of carbonic acid gas. Carbonic acid gas in the atmosphere in the proportion of 5 or 6 per cent. cannot be breathed without danger to life, and less than half that amount will be fatal when formed at the expense of the oxygen of the air. It is important also to remember that as we are continually breathing out carbonic acid gas, air in an enclosed space will soon become vitiated by the breath of human beings. The oxygen will be used up while the carbonic acid will be increased. If vitiated to any great extent suffocation will follow. A well-known and dismal example of this is the "Black Hole" of Calcutta, where out of 146 persons 123 died in one night in consequence of having been confined in a room 18 feet square with no adequate ventilation.

The breathing of impure air when not sufficiently vitiated to produce suffocation is one of the most frequent causes of disease. Typhus, poisoning of the blood and consumption naturally result from this.

One of the most potent causes of infectious disease is the breathing of air charged with exhalations from the lungs and skin of human beings, for such air is not only devoid of oxygen and charged with carbonic acid gas but also contains decomposed organic matter. Hence the violence with which epidemics rage in overcrowded districts. The breathing of air thus contaminated produces a condition of blood which renders it peculiarly susceptible to infectious poison, and it has been found that the fatality of epidemics is almost invariably in precise proportion to the degree in which an impure atmosphere has been habitually respired.

CHANGES OF AIR.

Normal Composition of the Air.

Atmospheric air is composed in its normal state of:—oxygen about 21 parts; nitrogen about 79 parts. There are other substances, but they are in such very small quantities as to amount to very little. They are carbonic acid, which is only 0·04 in 100 parts; watery vapour, which varies with the temperature of the air; a variable quantity of ozone and organic and suspended matters, which are found floating in the purest air, such as on mountain tops and on the plains, where impurities are not likely to reach. We do not generally perceive these small solid particles unless they are in great quantities.

Oxygen is an absolute necessity for the existence of all organic life. An ordinary man requires about twelve cubic feet of pure oxygen every twenty-four hours for existence alone, and as we have shown in discussing the subject of ventilation, he requires nearly half as much again when taking any physical exertion. All the lower animals require oxygen for the same purpose as human beings, and combustion of all kinds must be supported by oxygen, as in the burning of coal and wood and all lighting except the electric light. Vegetable life also needs oxygen; while the plant is growing it is continually inhaling oxygen and exhaling carbonic acid in a manner similar to that of men and animals, but under the influence of light the chlorophyll, which is contained in the leaves, absorbs a much larger proportion of carbonic acid than is exhaled by the plant, and in its action also gives off oxygen. From this it may be noted that although it is healthy to have plants in a living room in the daytime it is not desirable to keep them in a sleeping room during the night.

Nitrogen.—Very little is as yet known about nitrogen. The chief use appears to be to dilute the oxygen of the atmosphere which would be too strong if breathed alone.

Watery vapour.—The moisture or watery vapour in the atmosphere is essential to life. For if the air became perfectly dry it would draw all the moisture out of plants and animals and prove fatal to them. Water is always giving off vapour, slowly if the air is cold and more quickly if warm. The warmer the air the more moisture it can hold, up to a certain amount, which is called the point of saturation. As soon as the point of saturation is reached the moisture begins to condense and fall in dew, mist, rain, or snow as previously explained.

Ozone is now generally regarded by chemists as a condensed form of oxygen, it exists in very small quantities but is most plentiful in pure fresh air. It is thought to be produced where vegetation is abundant in open sunlight and is also contained in the air which blows over the sea. It has been called the scavenger of the atmosphere, for from its strong ozonising power it destroys organic matters and so purifies the air and diminishes the power of epidemics.

However an atmosphere containing too much ozone is too exciting and epidemics of gripe frequently occur in factories where it is artificially made for bleaching purposes.

Vitiation of the Air by Foreign Substances.

Carbonic Acid is the substance produced when carbon unites with oxygen. This union takes place when carbon is burnt, as in burning of coal. The union produces light and heat and gives off carbonic acid. We have seen that it is also given off from the bodies of men and animals, but is assimilated by plants for the manufacture of their tissues. The atmosphere is vitiated by carbonic acid when it exceeds the normal quantity of 0·04 in 100 parts, and the most ordinary cause of this vitiation is, as we have seen, our own respiration.

As long as we breathe free air these changes in the proportions of the elements of the air are of little importance and exercise but an insignificant influence on the vast reservoir which envelopes the earth; but it is altogether otherwise when we breathe in a limited space, and it is then that carbonic acid plays the principal part in rendering the air unfit for breathing, for from the moment that carbonic acid becomes too great, respiration is impossible and asphyxia may result. This is the point at which a lighted candle introduced into the room will burn faintly or go out.

Carbonic acid gas is sometimes exhaled from the soil and frequently collects in holes and caverns. It is sometimes produced by certain industries as in iron foundries.

Air vitiated with carbonic acid may act upon the organism either rapidly, producing asphyxia which is characterised by general sickness, deep anxiety and syncope; or it may act gradually producing abundant perspirations and feeling of suffocation. It actually brings about slow poisoning of the blood, and it is often the cause of scrofula and rickets among the poor living in crowded homes.

XII. WATER.

From a hygienic point of view water is as important as air. We have already seen how it exists in the atmosphere in the form of vapour, cloud, and fog, and how it effects various meteorological changes. It renders the temperature of the air more uniform and is an important agent in determining the sanitary condition of localities. Its influence on man may be summed up as follows: it supplies special qualities to the productions of the organic kingdom necessary for the nourishment of man, and thus modifies by indirect means the composition of the blood; as a drink it passes directly into the blood; as vapour in the air it acts on the skin and lungs, great humidity impeding the evaporation from these organs.

We have to consider here more particularly the part water plays when introduced into the human organism.

Physiological Function of Water.

Water forms more than two-thirds of the composition of the human body, a certain quantity of water is therefore an absolute necessity of life, and experience proves that the pangs of thirst are more difficult to endure than those of hunger.

Action of Water on Health.

The action of water on the health will depend on its temperature, on the quantity imbibed, and on the chemical qualities of the water.

Temperature.—Tepid water as a drink is debilitating and produces sickness. Hot water acts as a stimulant and in certain cases aids digestion. Cold water at the ordinary temperature, 45° to 50°, allays the thirst, and in cases of fever aids the function of the skin by promoting perspiration. Very cold water retards the circulation, lowers the temperature of the body and suppresses perspiration. The drinking of cold or iced water when the body is overheated is extremely dangerous, and has been known to produce diarrhœa, cramp, and inflammation of the stomach, and in some instances even to have caused sudden death. The danger is less however if the stomach contains food, as then the cold water does not come so immediately in contact with the mucous membrane. If too the body is not allowed to cool, but kept in a state of perspiration, by continued exertion, cold water may be drunk with greater impunity.

Quantity.—A healthy adult requires daily 70 to 100 ozs. of water for the processes of nutrition. About one-third of this is taken into the system in articles of food, many of which contain a large proportion of water, while the remaining two-thirds must be supplied in the form of liquids. To drink an excess of liquids is injurious, for the system will not assimilate more than is necessary for its nourishment, and the surplus has then to be got rid of. Thus extra work is thrown upon the skin and kidneys. Water should not be drunk until the end of the meal as its effect is to cool the stomach and thus retard digestion. Young children however may drink a moderate quantity with their food, as their digestion is inclined to be too rapid.

Chemical Qualities.—Water contains many mineral substances which affect the health in various ways.

Lime furnishes the necessary materials for the development of the skeleton and is an important element in drinking water. A deficiency of lime is a frequent cause of rickets in children. Infants cannot digest water unless it has been boiled, but lime must be afterwards added to restore the hardness lost in boiling. Bi-carbonate of chalk renders water more agreeable to the taste and at the same time aids digestion, but sulphate of chalk and magnesian salts irritate the intestines and produce colic and diarrhœa.

Impure Water.—Water is rendered impure by an excess of mineral substances, or by the presence of decomposing vegetable or of animal matter.

Certain mineral substances in water produce a special disease known as goitre; this disease prevails especially in certain Swiss valleys where the inhabitants can obtain little but minerally impure water. Headache and dyspepsia result if iron is present in too great quantities, while lead-poisoning has frequently resulted from the contamination of water by leaden pipes and cisterns. Any large amount of vegetable matter present in water is unwholesome, and likely to produce malaria. The most dangerous impurities, however, are those arising from the presence of putrescent animal matter. Water may be polluted by animal matter in various ways. Sewage is frequently discharged into rivers by sewers, and it often finds its way through the soil from cesspools into wells, while sewer gases may escape from imperfect drains into the cisterns of dwelling-houses. Water thus contaminated is converted into "a dangerous poison, fraught with disease and death." Germs of specific diseases, such as cholera and enteric fever, dysentery and diarrhœa, are frequently conveyed by impure drinking water.

Different kinds of Water.

Rain Water is water distilled by the rays of the sun, and in its original condition it is the purest of all waters. In its passage through the air, however, it becomes contaminated with impurities, and is far less suitable for drinking purposes than water derived from deep springs and wells. It is also wanting in salts and is heavy of digestion.

Snow or Ice Water is unwholesome, and difficult to digest. If under exceptional circumstances it is impossible to procure any other and it must be used, it should first be well beaten in the open air to lighten it as much as possible.

Distilled Water may be evaporated from sea water and is often used in long voyages. It should also be aërated, and requires the addition of saline matter.

Spring Water.—The quality of spring water will depend on the nature of the soil and rocks through which it has passed. The rain becomes charged with carbonic acid gas in its passage through the air, and by the agency of this gas dissolves the rocks with which it comes in contact as it makes its way underground, and thus becomes impregnated with mineral matters; and rising in springs it is sometimes so charged as to be fit only for medicinal purposes.

As a rule, however, spring water is the most wholesome and suitable for drinking, and should be used whenever possible to supply towns, &c., as its temperature and composition remain constant, and it is very little exposed to the causes of impurity which spoil river and well waters.

River Water by its constant movements becomes aërated. It is light and easy of digestion, but generally softer than well and spring water. It is, however, often impregnated with animal and vegetable matter, and requires careful filtering before use.

Well Water is hard and non-aërated, and is often open to suspicion of contamination from impurities of the surrounding soil finding their way into the water and rendering it dangerous.

Stagnant Water of ponds, bogs, &c., is quite unfit for use for drinking purposes, as it frequently contains the embryos of different kinds of intestinal worms.

Characteristics of Drinking Water.

A good drinking water should fulfil the following conditions :—It should be limpid, inodorous, light ; should be exempt from organic matter, and should contain a certain proportion of carbonic acid and of mineral salts. Impure water is sometimes to be detected by smell or sight but not always, as some of the brightest and most sparkling waters are found upon analysis to contain dangerous properties.

Purification of Water. Filters.

The system of filtering employed by English Water Companies is generally that of gravel filters. They consist of shallow reservoirs containing various layers of gravel and sand through which the water filters into an adjoining reservoir where it is again treated.

Domestic Filters.—Great care should be taken in the cleansing of domestic filters or they may become sources of contamination and danger, by reason of the decomposed organisms and other matters retained in them from previously filtered water. Filters which are so constructed that the filtering material cannot be easily removed should be abandoned altogether.

The principal materials in use for filters are spongy iron, magnetic iron, and animal charcoal. The charcoal when used should be frequently cleaned or renewed.

The Essentials of a Good Filter are that every part can be easily got at for the purpose of cleaning and renewing the medium; that the medium should possess a sufficient purifying power; that it should yield nothing to the water; that the purifying power should be reasonably lasting; that the material should not be liable to clog, and that the delivery of water should be fairly rapid. The "Filtre Rapide" of Maignen is an ingenious arrangement by which a large straining surface is presented to the water by spreading asbestos cloth over a perforated cone of porcelain; powdered charcoal is then mixed with a little water, and as the water passes through, the powdered charcoal settles on the cloth and forms the filtering medium; the charcoal can of course be removed as often as required.

Average Household Requirements.—An abundant supply of water is an important agent in health when viewed from the point of personal and domestic cleanliness, and we may conclude this chapter with a table showing the average daily quantity for household requirements.

Household Requirements:	Galls. per head per day.
Fluids as drink	0·33
Cooking	0·75
Personal ablution	5·00
Utensil and Housewashing... ...	3·00
Clothes Washing	3·00
Water-closets	5·00

XIII.—INFECTION AND CONTAGION.

Origin of Infectious Diseases.

Infectious diseases are those which can be communicated from one person to another. Careful investigations have, of late years, been made into the nature of these diseases, with the result that it is now generally believed that infection is carried by living organisms, so minute as to be visible only with the aid of the microscope and therefore called micro-organisms or microbes. This theory is known as the "Germ Theory of Disease." These microbes belong to the lowest form of animal life, and consist of a small speck of a jelly-like substance named protoplasm, which forms a link between the animal and vegetable kingdoms. They multiply by division of the protoplasm, each separate particle becoming an independent organism. All species of microbes are included under the term bacteria, but they are classified under different names according to the various forms they assume, and are known as micrococci, when round or oval, as spirilla when spiral, and as bacilli when rod-shaped. The whole atmosphere is teeming with microbes of some sort, but fortunately the greater number are harmless or even beneficial. Microbes may be taken into the body by breathing air which contains them, or they may be taken in food or in water. When the body is in a healthy state it is usually able to destroy or expel the microbes of disease, but if in a low and weak condition it can offer less resistance, and should these microbes, under these favourable conditions, succeed in implanting themselves, they will multiply with immense rapidity and spread the poison of disease throughout the system.

Most micro-organisms can exist independently of the human body and frequently lie dormant for long periods of time in clothes or furniture, retaining however almost undiminished their power of infection. Thus cases have been known of books, toys, &c., which have been packed away after having been used by a scarlet fever patient, giving rise when reproduced months or years afterwards to a fresh outbreak of the disease.

Specific Germs.—Most of the infectious diseases are produced by what are known as specific germs. A specific germ is one which is peculiar to the disease itself and which can only give rise to that disease; thus the germ of scarlet fever can only produce scarlet fever, just as a cherry-stone can only produce a cherry-tree, or an acorn an oak.

The principal infectious diseases are Cholera, Small-pox, Scarlet Fever, Measles, Diphtheria, Whooping-cough, Chicken-pox, Typhus and Typhoid Fever. These diseases are generally present to some extent, but frequently occur in such violent outbreaks, as to render them epidemic.

Malaria Fevers, Endemics, Epidemics.

A disease is said to be *endemic* when it is restricted to a certain locality and depends on causes peculiar to the place itself, as when fever haunts a marshy district, and *epidemic* when it breaks out suddenly and attacks many people in the same place and at the same time. In the latter case the infection may have been brought from a great distance and have no connection with the surroundings of the people then attacked.

It is in tropical and subtropical climates that *malarial fevers* and *ague* principally prevail but they are also common in some districts of Southern Europe. They are caused by a poison rising from decaying vegetable matter and are always connected with marshy evils. Warmth and moisture are favourable to the decomposition of vegetation and outbreaks of malaria usually occur when a season of heat and drought is followed by heavy rain. Trees absorb a great deal of moisture from the ground and are frequently planted in malaria soils with the effect of rendering them more healthy. Thus in the neighbourhood of Rome, certain districts formerly devastated by fever, have been rendered habitable by the planting of the Eucalyptus tree.

Ague was at one time common in the low-lying Fen districts of our own country, but has been almost entirely banished by the employment of a thorough system of subsoil drainage.

Precautionary Measures.

Diseases point to some violation of the laws of health, and may be traced to defective drainage, impure air, or bad water. Good sanitary surroundings, healthy dwellings, plenty of fresh air, pure water and personal cleanliness are the best safeguards against infection.

In time of epidemics all means within our power should be employed to maintain the body in a sound state of health, as if this is done it will most probably be able to resist any infectious influence from without.

Flannel should be worn to aid the functions of the skin and to protect the body from chills. Sufficient exercise in the open air is to be recommended, but it should never be carried to the point of fatigue. Food should be taken frequently and should be nourishing and digestible; exhaustion from want of food must on no account be allowed. Fear should never be given way to, for it is a depressing sentiment and increases the receptivity to disease. If the rules of health are conscientiously observed there is little occasion for alarm, as the risk of infection is comparatively slight.

Should infectious disease however have gained access to our homes then practical measures to prevent it spreading must at once be resorted to. The patient must be isolated in a room from which carpets and all unnecessary furniture, likely to harbour the germs of disease, have been removed, and those in attendance on the sick must be careful not to come into contact with other members of the household. Soiled linen should be put into liquid disinfectant before it leaves the sick room and should afterwards be boiled. All excreta must be at once disinfected, and must on no account be put down drains until this has been attended to.

It is well to remember that in the case of diphtheria infection is communicated principally by the breath; while in scarlet fever it is when the skin is peeling off the patient that the disease is most infectious. Sputa from the sick is highly infectious; in dealing with whooping-cough special care is required on this account.

Disinfectants.—A disinfectant is a substance which kills the micro-organisms; an antiseptic impedes or arrests their growth but does not destroy them; a deodorant renders unwholesome effluvia imperceptible to the sense of smell. The distinction between disinfectants and deodorants should be carefully drawn. The latter are useful to sweeten and freshen the air of a sick room, but must not be relied on to do the work of disinfectants. It should always be remembered that to mask a bad smell under a stronger smell is not to remove the cause of danger. The sense of smell is a safeguard given us by nature, as it warns us of something injurious to health in our surroundings, which ought at once to be got rid of.

In case of illness suitable disinfectants will of course be recommended by the medical man in attendance.

Permanganate of Potash may be mentioned here, but it will only act as a disinfectant when used in a much stronger solution than the preparation known as Condy's Fluid. The latter, with terebene and sanitas, are useful as deodorants.

Fresh air is an important agent in disinfection, for not only will it dilute the poison of disease, and thus render it less powerful, but oxygen it is believed exerts a direct chemical action on the microbes. The ventilation of the sick room must therefore be well attended to; close confined air greatly increases the risk of infection.

At the close of the disease the clothing and bedding of the patient, with the sick room and all the furniture contained in it, must be thoroughly disinfected. Books, or any things of little value, which have been used by the patient in his illness should be at once burnt.

XIV.—PRINCIPAL BIOLOGICAL CONDITIONS.

The biological conditions to be considered are those of individual life and the functions of age, sex, constitution, hereditary temperament and habits.

Age.—At different periods the organism undergoes certain changes which bring about physiological and pathological changes proper to those special periods.

The divisions of these periods adopted by authorities vary greatly, we will take the following:—

Infancy; extending from birth to the age of six months. This is the period in which the baby gets accustomed to independent life; the organs have with difficulty to accustom themselves to the new conditions imposed upon them, hence infants are very liable to certain maladies: bronchitis, pneumonia, diarrhœa, and ophthalmia.

It is very necessary to carefully protect a newly born baby against the cold; it should be kept well covered and not exposed too soon to the air, even in warm weather. After the infant is a month old it should be taken out at least twice a day in fine weather, the only necessary precaution being that it is sufficiently clothed, and that its head be protected from the sun.

The Bath.—Cleanliness is of great importance to the healthy growth of children. An infant should have a tepid bath twice in twenty-four hours. After two months the tepid bath in warm weather should *gradually* give place to cold. But no child should have a cold bath more than once a day.

Clothing should be loose, soft, light, warm, arranged to fit without pins and to cover the legs, arms and neck.

Sleep.—Except in earliest infancy or very cold weather an infant should sleep apart from the mother or nurse in a cot, care being taken that it is warmly but not excessively covered. A healthy infant spends the chief part of its time in sleep, and even up to the third year a mid-day sleep is beneficial.

Feeding.—Maternal milk is the most natural food for infants if the mother is healthy; and suckling is the best method of feeding. An infant requires no other food than breast milk till the fifth or sixth month. Regular habits of feeding must be established from the first.

The best substitute for maternal milk is asses milk, or if this cannot be obtained, cow's milk assimilated to human milk by dilution with water and the addition of sugar-of-milk. This should be given through the modern feeding-bottle with an elastic tube, but great care is required in the use of it. Absolute cleanliness is of the utmost importance. The bottle as well as the tube and teat should be thoroughly washed after each meal and always kept in a basin of cold water when not in use. Neglect of scrupulous attention to the feeding-bottle is a frequent cause of indigestion, thrush, &c.

Advanced Infancy from six months to two years. This period is chiefly characterised by the cutting of the first set of teeth. The child should generally be weaned from its mother between the ninth and eleventh month. After the sixth or seventh month it is best to supplement the milk with some farinaceous food, and as the child advances eggs, gravy, fish, &c., may be added, but meat need not be added till about two years of age, and then only very gradually. Tea and coffee should always be withheld from children, but cocoa is a suitable beverage at any period after infancy. During this period the first set of teeth are generally completed. Ordinarily in this order:—About the sixth month come the two middle incisors of the lower jaw, followed in a few weeks by the corresponding incisors of the upper jaw, next the two outside incisors of the lower jaw, and soon after those of the upper; after an interval of perhaps two months the first four molars, then the eye teeth, and lastly four other molars, making twenty teeth in all for the first set. As the first set falls out it is replaced by the permanent set, which is not completed till adult life.

Childhood.—From two to seven years is a period of many infantile complaints, such as eruptive fevers, croup, whooping cough, all of which are largely preventible by obedience to proper hygienic conditions.

Youth.—From seven to fifteen years is a period when children's systems must be carefully built up. It is a period of quick growth, and in consequence of the exhaustive changes going on throughout their system, they are liable to rickets, scrofula, and consumption. Care must be taken that enough flesh and bone-forming matter is supplied in the food to meet the demands made by the system.

Puberty.—From fifteen to twenty is the period characterised by the complete development of the organs of reproduction, and by the commencement of menstruation in women. This is a period that would not be so frequently attended with specific tendency to disease in girls if their modes of life were more in accordance with the rules of health. For although disorder of the menstrual function is a most common phenomenon in female youth it is frequently the symptom of general defect of nutrition and of an impoverished condition of the blood rather than a disease in itself.

Period of Maturity.—The cessation of growth and complete development which shew the attainment of manhood shew also a marked increase in general vigour and in the powers of endurance. The apparatus of the animal life being more fully developed the sole purpose of food is to keep the apparatus in good working order, hence so much food is not required as during the period of growth. The observing faculties and the emotional sensibility are not so keen as formerly, but the intellectual powers now act in the ways that have become habitual to them, and have more sustained vigour and completeness than they previously possessed.

Period of Decline is the time when the hair becomes white and falls, the teeth decay. The general decline of the vital powers has received the name of "climateric disease," and leads on to

Old Age.—When with declining bodily and mental energy the experience of a long life gives value to the judgment, "Young all lay in dispute; I shall know being old." And now, unless any accident intervene, the circulation and the respiration gradually decline until the life of the organism becomes extinct, and death occurs releasing the life of the spirit to breathe that purer atmosphere where "Death is swallowed up of victory."

Sex.—The difference in the nervous system of the sexes shews itself most strongly during the period of maturity. The chief physical inferiority of woman to man is shewn in the lesser weight of her brain. The intellectual powers of woman are, therefore, generally inferior to those of men in sustained mental exertion, in comprehensiveness of judgment, and in originating; but a woman's intuitive powers are generally greater, giving her more ready sympathy and tact than men possess. The emotions, therefore, predominate, and by their direct influence upon the body produce important changes in the organic functions.

The indoor life which is so largely imposed upon women very markedly encourages the development of nervous diseases to which she is particularly subject, while the outdoor life of men exposes them to greater risk of chills, rheumatism, &c. Beside paying careful attention to food and clothing women must endeavour to obtain sufficient outdoor exercise to maintain health, while men must not disregard the preventive measures which they may easily take against illness in the matter of suitable clothing.

It should be noticed that the average length of woman's life is greater than that of man.

Constitution.—Constitution is the general name given to the particular organisation of each individual, and is modified by the words strong and weak. The strength of the constitution depends upon—The healthiness of the different organs, the regularity of the physiological play of the different functions, the degree of physical force, the resistance to causes of disease, and the vital energy.

Temperament.—Constitution is the basis of individual nature, temperament is its more or less constant form.

Temperament may be distinguished as sanguine, lymphatic, nervous, bilious and choleric.

In the "Sanguine Temperament" there is a rapid circulation and the organs are kept well supplied with all necessary matter; an excess of this temperament brings about plethora. The sanguine temperament gives a particular acuteness to feverish attacks which affect in an inflammatory manner; any simple illness soon assumes an acute form, the symptoms are well marked, they follow a regular order, the evil rarely becomes chronic and is generally quickly cured, the convalescence is short. The sanguine temperament is exposed to hemorrhages and enlargement of the heart.

Those of a sanguine temperament should avoid stimulants, bitter and aromatic seasonings, and especially alcohol and coffee; they should abstain from violent exercise and avoid great heat and stuffy rooms.

The "Lymphatic Temperament" is characterised by predominance of vitality and action in all the tissues penetrated by white liquids, mucous serum, &c.

The hygienic rules for those of a lymphatic temperament are as follows; they should have plenty of fresh air and never allow their rooms to get hot and close, they should live on high dry ground and avoid all humidity. Exercise should be taken, but always in moderation. Their food should be of a strengthening reconstituting kind, including very little vegetable matter or white meat, and no unfermented farinaceous food.

In the "Nervous Temperament" the organic power of resistance contrasts with an apparent weakness; the sensations are very mobile; the nervous system is very susceptible, there is an almost incredible exaggeration of all impressions, everything is either intense pleasure or great unhappiness. Under such conditions care should be taken to strengthen the digestive powers, to help the formation of blood and to develop the muscular system. Cold baths and exercise, especially gymnastics, are especially useful for calming the exaggerated excitability of the nervous system, and for substituting physical activity for the action of the brain.

The nervous temperament is the one that produces heroes, poets, musicians, &c.

The "Bilious Temperament" is characterised by the excess of the bilious functions; the skin gets a dark colour and sometimes a yellowish tint; the muscles are vigorous; the bones strong, digestion is good, the passions intense and lasting, the character firm, decided and perserving.

The hygienic rules for this temperament are:—A moderate diet; stimulants in small quantities; fat and sweet substances should be abstained from, and the diet should be chiefly vegetables with little milk; a great deal of exercise should be taken.

The different types of temperament which we have been studying, rarely exist alone. they are more often combined and form a mixed temperament.

Heredity.—By heredity is understood a disposition, by virtue of which certain physiological and pathological characteristics are transmitted to the next generation.

Physiological heredity shews itself by the transmission of the general figure, habits, character, morals, disposition, and intellectual faculties of the father or mother.

Pathological heredity shews itself by the transmission of deformity, imbecility, deafness, blindness, &c., and a predisposition to certain diseases such as muscular rheumatism, gout, cancer, consumption, paralysis, softening of the brain. Marriages between blood relations have a most disastrous effect in families affected with hereditary diseases, as it increases the chances of the transmission of evil to their offspring.

Gymnastic exercises seem to be indicated as an especially happy method of modifying the organisation of a child and nullifying the effects of an unhealthy hereditary predisposition. There is much more probability of reinstating a vitiated organism by the hygienic means of food and exercise than by the use of medicinal agencies.

Habits.—A movement or act that at first demands attention for its execution comes naturally or automatically after a time if often repeated, for the nerve force is disposed to pass in special tracks marked out for it by these repeated movements. The act then becomes a habit. The nervous system thus acquires a number of actions which are solely automatic, and may afterwards be put into play without consciousness taking any part in them. This is why in youth while the organism is growing most rapidly and the greatest amount of new tissue is being formed we find new connections most readily established, hence it is the time when impressions are strongest and leave the most lasting imprints. Therefore it is so necessary in youth to watch the formation of habits and to direct the development of the organism.

Habit modifies all the functions of the system, for as we have seen even the lungs may become accustomed to breathe foul air without being immediately poisoned by it. And the stomach may habituate itself to taking food at such regular hours that hunger or thirst is not felt at other times; sleeping and waking too are easily regulated by habit.

Although habit may have one disadvantage in the fact that a variation from habit may cause the organism great suffering, yet the advantages of habit from a hygienic point of view are on the whole so great that we cannot do better than close this book by referring to the large questions of Temperance set out by Dr. Parkes in his teaching on "Individual Hygienic Management," and strongly urging that all of these should be made a matter of habit.

Temperance.—Sufficient food must be taken for wants but not for luxuries, with variety enough to stimulate appetite. Slow and proper mastication must be adopted in order to avoid the evils of dyspepsia. Attention must be given to the skin; to the care of the bowels: to the reproductive organs, that they are not allowed by too early or too frequent use to become a drain on the system preventing the attainment of strength and endurance needed for happy vigorous life. Care must be taken to the teaching of this truth to the youth of both sexes. General good temper, cheerfulness, and hope must be sustained, that the greatest amount of mental work may be borne without injury. It must be remembered that however much the adult is under the influence and control of others in no case is self-control taken away, an individual can always influence the conditions of his own health.

Let us hope that it may soon become the habit to think that in education, matters such as the laws of health and physiology should not always be considered of less importance than the languages of extinct nations or the unimportant facts of a dead history.

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